DIETARY INTAKE OF CHILDREN WITH AUTISM SPECTRUM DISORDER (ASD) ENROLLED IN A SUMMER CAMP

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ABSTRACT

THESIS: Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp

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Children with autism spectrum disorder (ASD) experience substantially more feeding problems compared to children without ASD, putting this population at an increased risk for nutrient deficiencies. These deficiencies can often be compounded by "elimination diets" which many parents provide in an effort to reduce their child's symptoms. Little to no research exists to demonstrate the effectiveness of nutrition education interventions in children with ASD, warranting the need to find ways to optimize their diet and ultimately their growth and development. Thus, the purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. The parents of 21 children (6-12 years) with ASD were invited to participate in the nutrition education intervention, and 12 attended the session. Parents completed a pre-, peri-, and post-test food frequency questionnaire (FFQ) to measure the dietary intake of their children and to monitor changes. The results indicated a statistically significant difference in the frequency of daily sweet ($x^2 = 6.75$, $df = 2$, $p = .034$) and snack ($x^2 = 6.75$, $df = 2$, $p = .021$) consumption by children with ASD. Nutrition education interventions administered by registered dietitians can improve the dietary intake of children with ASD.

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CHAPTER 1

INTRODUCTION

Autism Spectrum Disorder (ASD) is a group of developmental disabilities characterized by impairments in social interaction and communication, and by restricted, repetitive, and stereotyped patterns of behavior (American Psychiatric Association, 2000). It is estimated that about 1 in 68 children have been identified with ASD, with the prevalence being four and a half times higher among boys than girls (Christensen et al., 2016). An insistence on routines and being aversive to change can cause daily activities, such as eating, sleeping, and routine care (i.e., haircuts) to be extremely difficult (Black & Grant, 2014). However, symptoms of ASD are viewed as being on a spectrum, meaning these symptoms can range anywhere from mild-to-severe (Black & Grant, 2014). Thus, individuals with ASD have varying degrees of capabilities (Black & Grant, 2014).

Children with ASD and atypical oral sensitivity display increased food avoidance behaviors, placing them at a higher risk of potential nutrient deficiencies (Kral et al., 2015). Additionally, these children tend to have increasingly problematic feeding and mealtime behaviors regardless of functioning level (Johnson et al., 2014). A greater risk for general gastrointestinal (GI) concerns, constipation, diarrhea, and abdominal pain has also been observed for children with ASD compared to children without ASD (McElhanon, McCracken, Karpen, & Sharp, 2014). Increased anti-gliadin antibody response has been found to be associated with GI

symptoms, pointing to a potential mechanism involving immunologic and/or intestinal permeability abnormalities in affected children (Lau et al., 2013).

Although children aged 2-18 years in the U.S. have increased their total fruit intake by consuming more whole fruits, only children aged 2-5 years met the *Healthy People 2020* target of 0.9 cup- equivalents per 1,000 calories (CEPC) fruits and no socio-demographic group met the target of 1.1 CEPC for vegetables (Kim et al., 2014). This observation is similar among children identified with ASD, who reported lower than recommended intakes of vitamin A, D, and K, calcium, choline, fiber, magnesium, phosphorus, and potassium (Hyman et al., 2012). Zimmer et al. (2012) found that, compared to controls, those with autism consumed inadequate intakes of calcium, zinc, vitamin B12, and vitamin D. If children with ASD are on a gluten-free and/or casein-free diet (GFCF), adequate substitution from other dietary sources may be necessary to prevent nutrient deficiencies (Graf-Myles et al., 2013). Children with a limited range of accepted foods may indicate interventions involving dietitians and other specialists to encourage the consumption of a greater variety of foods (Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela, 2015).

Children diagnosed with ASD often utilize complementary and alternative medicines (CAMs) when they have co-existing gastrointestinal symptoms, seizure disorders, and behavioral problems (Perrin et al., 2012). According to Senel (2010), “Vitamins and minerals” and “Special Diet” were the most frequently used and were demonstrated to be most beneficial as CAM treatments by parents of children with ASD. Parents who have tried different forms of CAM methods believe that most treatments and therapies have resulted in some degree of improvement for their child with ASD (Goin-Kochel, Mackintosh, & Myers, 2009). Children who may benefit from a GFCF diet include those with GI symptoms, food sensitivities, or food allergies (Pennesi

& Klein, 2012). However, in order to determine diet effectiveness, the GFCF diet should be implemented for more than 6 months and strictly adhered (Pennesi & Klein, 2012). It is important to note that isolating the effects of this diet are difficult due to the implementation of various CAMs at one time, warranting additional research (Winburn et al., 2014).

Nutrition education programs in schools have shown to be beneficial for children by improving health-related parameters, lifestyle behaviors, parents' attitudes toward planning their children's diets, and improving parents' own personal eating habits (Muros, Zabala, Oliveras-López, Ocaña-Lara, & de la Serra, 2013; Hu et al., 2010). When children with attention deficit hyperactivity disorder (ADHD) were encouraged to increase their intake of a recommended diet, attention improved (Ghanizadeh & Haddad, 2015). However, little research has been conducted in an ASD population specifically attending a summer camp to determine the effectiveness of nutrition education among this population. Thus, identifying successful strategies to increase nutrient intake, improve diet quality, and promote optimal growth and development of children with ASD is warranted.

Problem

An estimated 1 in 68 children have been identified with ASD, a developmental disability that can cause significant social, communication and behavioral challenges (Christensen et al., 2016). Children with ASD and atypical oral sensitivity display increased food avoidance behaviors, placing them at an increased risk of potential nutrient deficiencies (Kral et al., 2015). Children with a limited range of accepted foods may indicate interventions involving dietitians and other specialists to encourage the consumption of a greater variety of foods (Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela, 2015). Children who

may benefit from a GFCF diet include those with GI symptoms, food sensitivities, or food allergies (Pennesi & Klein, 2012). Since nutrition education interventions have been found to be beneficial in typically developing children and children with ADHD, these benefits should also be explored for other specialized pediatric populations with various health disorders (Muros, Zabala, et al., 2010; Ghanizadeh et al., 2015). Thus, in an effort to prevent nutritional deficiencies and to promote optimal growth and development in this special population, the implementation and evaluation of nutrition education programs for children with ASD and their parents is warranted.

Purpose

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data.

Research Questions

Using results from a FFQ obtained from the parents of children with ASD who attended a summer camp that included nutrition education, and observations of home-packed lunches, the following research questions were examined:

1. Were there changes in the number of food groups consumed per day by children with ASD between one week prior to camp (pre-test), week 5 (during camp, peri-test) and week 9 (one month after camp, post-test)?
2. Was there a change in food consumption of children with ASD after parental nutrition education (after week three)?

3. Were there changes in the nutrient composition of home-packed lunches brought and consumed by children with ASD between week 1 (baseline) and week 5 (during camp)?
4. Were there changes in nutrient composition (macro- and micronutrients) of the lunches brought to the camp by child BMI?

Rationale

There have been substantial increases in the estimated prevalence of ASD in the U.S. since the 1990s (Christensen et al., 2016). Children with ASD tend to have restricted, repetitive patterns of behavior, interests, or activities that result in an insistence on routines and being aversive to change (Black & Grant, 2014). In addition to having sensory sensitivities, activities such as eating, sleeping, and routine care can be extremely difficult (Black & Grant, 2014). Thus, nutritional deficiencies are more commonly seen in children with ASD compared to normal developing children (Sharp et al., 2013). It is known that adequate nutrition is necessary for this critical time of growth that occurs for children during this phase of their life. Nutrition education interventions are a means to improve the nutrition status of a particular subset of individuals. Therefore, nutrition education for children within this population is necessary in order to prevent the hindrance of growing and developing to their full potential.

Assumptions

The researcher makes the following assumptions in the implementation of the study and in the interpretation of the data:

1. The study participants were able to read and understand English.

2. The study participants understood the directions when completing the food frequency questionnaire.
3. The study participants understood the questions being asked of them.
4. The study participants answered the food frequency questionnaire questions honestly.
5. The questions asked by the food frequency questionnaire adequately and accurately reflected the information presented during the nutrition education lesson.

Definitions

For the purpose of this study, the following definitions were used:

1. Autism Spectrum Disorder: a neurodevelopmental disorder with essential features of persistent deficits in reciprocal social communication, in nonverbal communicative behaviors used for social interaction, in developing, managing, and understanding relationships (Criterion A) and restricted, repetitive patterns of behaviors, interests, or activities (Criterion B). Autistic disorder, Rett's disorder, childhood disintegrative disorder, Asperger's disorder, and Pervasive Developmental Disorder Not Otherwise Specified (PDD-NOS) fall under autism spectrum disorder (Black & Grant, 2014). Autism is another name for ASD.
2. Typical/Normal Child Development: Children that acquire a wide range of skills similar to the majority of children their same age within their same culture. Development also entails maturation, achievement of developmental milestones, developmental sequence of skills, and age level expectations (Children's Medical Services, 2012).

3. Nutrition Education: Any combination of educational strategies, accompanied by environmental supports, designed to facilitate voluntary adoption of food choices and other food and nutrition-related behaviors conducive to health and well-being; nutrition education is delivered through multiple venues and involves activities at the individual, community, and policy levels (Contento, 2007).
4. Nutrition Intervention: Action is taken with the intent of changing a nutrition-related behavior, risk factor, environmental condition, or aspect of health status (Winterfeldt, Bogle, & Ebro, 2017).
5. Micronutrient Deficiencies: Also widely known as hidden hunger, is when the intake of micronutrients, such as vitamins and minerals, are below the amount required, but not so severe that typical clinical symptoms such as rickets, scorbut, or xerophthalmia occur (Jati et al., 2014).
6. Complementary and Alternative Medicine (CAM): CAM covers a heterogeneous spectrum of ancient to new-age approaches that purport to prevent or treat disease. Complementary interventions are used together with conventional treatments, whereas alternative interventions are used instead of conventional medicine (Barnes & Bloom, 2008).
7. Gluten-Free, Casein-Free Diet: A diet that eliminates gluten (found in wheat, rye, and barley) and casein (the main protein in dairy products) (Elder, 2008).
8. Food Groups: Fruits, vegetables, grains, protein foods, and dairy (USDA, 2017).
9. Dietary Intake Assessment: Provides detailed benchmark data on food and nutrient intakes of the population to monitor the nutritional quality of diets (Boyle & Holben, 2012).

10. Nutrient composition: Macronutrient (carbohydrate, protein, & fat) and micronutrient (vitamins & minerals) content of foods (USDA, n.d.).
11. Underweight: The BMI-for-age is less than the 5th percentile (CDC, 2015).
12. Normal Weight: The BMI-for-age falls within the range of the 5th percentile to less than the 85th percentile (CDC, 2015).
13. Overweight: The BMI-for-age falls within the range of the 85th percentile to less than the 95th percentile (CDC, 2015).
14. Obese: The BMI-for-age is the 95th percentile or greater (CDC, 2015).

Summary

Characteristics associated with the neurodevelopmental disorder, ASD, make it difficult for these children to have optimally nutritious diets. Not only are these children aversive to change, but they also tend to experience more sensory issues that interfere with the eating process as well. Most children and adolescents around the U.S. do not meet the dietary guidelines for fruit and vegetable consumption. If typically developing children struggle with consuming an optimally nutritious diet, children with ASD that have various factors working against them, certainly have a difficult time consuming an optimally nutritious diet. There are also GI concerns in this population, which are not always expressed verbally due to social deficits, and may be a contributing factor of mealtime issues. Having a dietitian that can be a part of the multidisciplinary approach needed for this population is warranted, since dietitians are the experts on nutrition. Although little research exists that measures the effectiveness of nutrition education for children with ASD, other studies involving typically developing children and children with ADHD have demonstrated benefits from such an intervention. Due to the various

challenges presented with this population related to obtaining optimal dietary intake, these children could benefit tremendously from a nutrition education intervention.

CHAPTER 2

REVIEW OF LITERATURE

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data. This chapter will present a review of the literature that describes ASD, the diet quality of children, relevant complementary and alternative medicines (CAMs) for children with ASD, and nutrition education interventions or camps.

Autism Spectrum Disorder (ASD)

Definition

Black & Grant (2014) describe ASD as being a neurodevelopmental disorder that can hinder growth and development, and is often present in infancy or early childhood that, unfortunately, often goes undetected until the child enters school. The diagnosis of ASD has taken the form of a different concept, being a "spectrum" that includes all of the various disorders previously distinguished in the DSM-IV (American Psychiatric Association, 2000). Essential features of ASD include persistent deficits in reciprocal social communication, nonverbal communicative behaviors used for social interaction, and in developing, managing,

and understanding relationships (Criterion A), along with restricted, repetitive patterns of behaviors, interests, or activities (Criterion B). In the home, an insistence on routines and being aversive to change, along with sensory sensitivities, may negatively interfere with eating, sleeping, and routine care (e.g., haircuts, dental appointments), ultimately making these activities extremely difficult (Black & Grant, 2014).

Statistics

Christensen et al. (2016) described the combined estimate of the prevalence of ASD for 2012 among the 11 Autism and Developmental Disabilities Monitoring (ADDM) Network sites as being 14.6 per 1,000 (1 in 68) children aged 8 years. There has been a substantial increase in the reported estimated prevalence of ASD in the U.S. since the 1990's. The prevalence of ASD is 4.5 times higher among boys aged 8 years (23.6 per 1,000) than girls aged 8 years (5.3 per 1,000). In addition, the estimated prevalence is significantly higher among non-Hispanic white children aged 8 years (15.5 per 1,000) compared with non-Hispanic black children (13.2 per 1,000), and Hispanic (10.1 per 1,000) children aged 8 years.

Dietary-Related Considerations

Kral et al. (2015) conducted a pilot study to compare weight-related outcomes and caregiver-reported child eating behaviors among children with ASD and typically developing (TD) children aged 4-6 years. In addition, the authors sought to examine feeding practices of caregivers of children with ASD and TD children. The caregivers of these children (n = 25 children with ASD; n = 30 TD children) completed a series of questionnaires and participated in one on-site assessment to obtain measurements of children's height, weight, and waist circumference. The series of questionnaires included the Child Food Neophobia Scale, Child Eating Behavior Questionnaire (CEBQ), Child Feeding Questionnaire (CFQ), Parental Feeding

Style Questionnaire (PFSQ), and Sensory Profile Caregiver Questionnaire. Independent samples *t* tests were utilized for continuous variables, while nonparametric tests, Chi-Square, and Fisher's Exact tests were utilized for categorical variables. Results indicated the children with ASD showed a significantly higher waist circumference ($p < .05$; $p = .01$) and waist-to-height ratio ($p < .001$). Children with ASD showed significant differences in their total score on the social communication questionnaire (17.4 ± 5.6 vs. 5.9 ± 3.3; $p < .001$) and the oral sensory sensitivity factor (29.4 ± 10.4 vs. 39.5 ± 8.5; $p < .001$). Children with ASD also showed significantly greater food fussiness ($p < .001$) when compared to TD children. Children with ASD and atypical oral sensory sensitivity, when compared to children with ASD with typical oral sensory sensitivity, showed significantly greater food avoidance behaviors, such as food neophobia ($p = .004$), food fussiness ($p = .03$), and greater emotional under eating ($p = .02$), respectively. Caregivers of children with ASD with atypical oral sensory sensitivity reported utilizing food to regulate negative child emotions to a greater extent than caregivers of children with typical oral sensory sensitivity ($p = .02$). The researchers concluded that increased food avoidance behaviors can put children with ASD and atypical oral sensory sensitivity, at an increased risk for potential nutrient deficiencies, adversely affecting their growth and development. Future research is needed to determine the extent to which these food avoidance behaviors in children may be food-specific, and if they can be modified through targeted behavioral interventions. Martins, Young, & Robson (2008) similarly reported that children with ASD had slightly poorer feeding skills and were more likely to avoid foods and exhibit food neophobic behaviors compared to typically developing children.

Zobel-Lachiusa, Andrianopoulos, Mailloux, & Cermak (2015) conducted a study to investigate the association between mealtime behavior problems and sensory differences in

children with ASD compared with their TD peers. The sample for this study consisted of 68 children between the ages of 5 and 12 years. A survey packet was delivered by mail or hand delivery to the parents of these children, and consisted of the study description, the demographic survey form, four questionnaires including the Short Sensory Profile (SSP), Sensory Eating Checklist, Touch Inventory for Elementary School Aged Children, and Brief Autism Mealtime Behavior Inventory (BAMBI). Lukens & Linscheid (2008) reported that BAMBI demonstrated good internal consistency, high test-retest reliability, a clear factor structure, and strong construct and criterion-related validity in measurement of mealtime behavior problems in children with ASD. Significant differences were found between the groups for the mean scores on all three sensory measures, with the ASD group showing greater sensory differences ($p = .001$). Significant differences were also found between the groups for the BAMBI total score ($p = .001$). The ASD group had a BAMBI score of 44.39 versus a score of 30.08 in the TD group, indicating more mealtime behavior problems in children with ASD. Thus, the ASD group showed significantly greater sensory differences and mealtime behavior problems than the TD group, which was determined via independent-samples *t* tests. When correlational analyses were run for each group, moderate to strong correlations were detected between eating behaviors and the sensory measures for the ASD group. A 2 x 7 ANOVA identified a statistically significant difference between the groups for all SSP subscales ($p < .001$). Future studies should include additional quantitative and qualitative data obtained on each participant, utilizing more direct assessment and observation of potential eating and sensory behaviors, in order to eliminate potential bias and increase objectivity. In conclusion, children with ASD tend to be more problematic during mealtimes compared to their TD counterparts due to greater sensory issues and mealtime behavior problems. Johnson, Handen, Mayer-Costa, and Sacco (2008) similarly

reported that parents of children with autism rated more feeding problems, particularly in relation to the refusal of foods based on color, texture, and type in comparison to parents of typically developing peers.

Johnson et al. (2014) conducted a study to extend previous work by describing the interrelationships between core and associated behaviors of ASD with feeding and mealtime behaviors, along with the relationship between feeding behaviors and nutritional well-being. Parents of children with ASD (n = 256 children) completed a Brief Autism Mealtime Behavior Inventory (BAMBI), the Autism Diagnostic Observation Schedule (ADOS), a Cognitive Assessment, the Repetitive Behavior Checklist Revised (RBSR), a Short Sensory Profile (SSP), a Child Behavior Checklist (CBCL), and a Healthy Eating Index (HEI). The sample of these children were primarily male (84%) and Caucasian (90%). Results indicated the BAMBI, RBSR total score (0.597), and BAMBI, SSP (-0.480) were highly correlated. The internalizing (0.418) and externalizing (0.409) scores from the CBCL were positively correlated with the BAMBI. The BAMBI was negatively correlated with the HEI (-0.306). Linear regression determined that for both externalizing and internalizing t-scores of the CBCL, each unit increase was associated with a significant increase in the BAMBI total score ($p < .0001$). Additionally, for each unit increase in the RBRS total score, the BAMBI total score increased by 0.28 and for each increase in the SSP total score, the BABMI total score decreased by 0.26. When controlling for medications, each unit increase of the BAMBI total scores, the HEI decreased by 0.31, indicating that nutrition quality decreased as problem feeding behaviors increased ($p < .0001$). The findings from this study suggest a multidisciplinary approach is needed for children with ASD, including the expertise of a dietitian, due to the relationship between the HEI and parent reported feeding behaviors. Interventions addressing the need for an interdisciplinary team are clearly absent in

the literature. In conclusion, there are strong links between higher rates of repetitive behaviors, sensory differences, and both externalizing and internalizing behaviors and increasingly problematic feeding and mealtime behaviors regardless of functioning level. Thus, children with elevated symptoms in any of these areas should be screened for suboptimal mealtime and feeding behaviors, along with nutritional inadequacies.

McElhanon, McCracken, Karpen, & Sharp (2014) conducted a meta-analysis to identify studies utilizing empirical methods to investigate GI diagnoses, signs, and symptoms among children with ASD and to summarize the evidence based upon descriptive and meta-analytic procedures. Medline, PsycINFO, and PubMed databases were searched for peer-reviewed journals. The analysis involved studies with a comparison group, presenting quantitative data on GI symptoms, and utilizing a combination of terms for ASD and GI indicators. Inclusion criteria for the meta-analysis included: a sample of a pediatric population (birth to 18 years of age) with ASD, a non-ASD comparison group without identified neurobehavioral delays to analyze GI problems, and the study presented data on GI symptoms descriptively or statistically. Fifteen studies (n = 2215 children) were yielded as a result of the systematic search. A random-effects model was utilized to calculate effect sizes and 95% confidence intervals. Children with ASD experience a statistically significant 4.42 greater increase in the prevalence of general GI symptoms compared to children without ASD ($p < .001$). Children with ASD also tend to experience a 3.53 greater increase in the prevalence of diarrhea, and a 3.86 greater increase in the prevalence of constipation, both being statistically significant ($p < .001$) in comparison to children without ASD. Lastly, children with ASD experience a statistically significant 2.45 greater increase in the prevalence of abdominal pain compared to children without ASD ($p < .05$). Future studies are needed to explain the etiology, prevalence, topography, and remediation

of GI problems in ASD, with consideration of the potential linked contributions of factors, such as mucosal barrier dysfunction and immune abnormalities. In conclusion, children with ASD exhibit a greater risk for general GI concerns, constipation, diarrhea, and abdominal pain compared to children without ASD. However, conclusions about the nature and etiology of the observed associations remain uncertain.

Lau et al. (2013) conducted a study to assess the potential link between autism and celiac disease. The participants of the study (n = 140 children) included 37 children with autism, 27 unaffected siblings of similar ages within the same families, and 76 unrelated healthy controls. Serum specimens were tested for antibodies to native gliadin, deamidated gliadin, and transglutaminase 2 (TG2). Affected children were genotyped for celiac disease associated HLA-DQ2 and –DQ8 alleles. Differences between groups were analyzed by the two-tailed Student's *t* test, Welch's *t* test, Mann-Whitney U test, or ANOVA with post-hoc Dunn test (continuous data), and the Fisher's exact test (nominal data). Children with autism had significantly higher levels of IgG antibody gliadin compared with unrelated healthy controls ($p < 0.01$). The IgG anti-gliadin antibody response was significantly greater in the children with autism with GI symptoms in comparison to those without them ($p < 0.01$). GI symptoms available from medical histories of children with autism included diarrhea (10 children), gastroesophageal reflux (2 children), frequent stools (3 children), constipation (3 children), and non-specified GI symptoms (1 child). Further confirmation in larger and better-characterized cohorts of patients and controls are needed for the conclusions of this study. In conclusion, a subset of children with autism displayed increased immune reactivity to gluten, in which the mechanism appears to be distinct from that in celiac disease. The increased anti-gliadin antibody response, and its association with

GI symptoms points to a potential mechanism involving immunologic and/or intestinal permeability abnormalities in affected children.

de Magistris et al. (2010) conducted a study to verify whether the GI barriers were actually impaired, and whether gut inflammation was present in a large cohort of patients with ASD and in their first-degree relatives, utilizing noninvasive tools. The participants of this study included 90 children with ASD, 146 of their first-degree relatives, and control groups of 64 children and 146 adult normal subjects. All participants were given an intestinal permeability test (IPT test), while all of the patients and their first-degree relatives underwent a faecal calprotectin (FC) determination, to investigate GI inflammation. All participants who displayed high values of IPT and/or FC underwent blood tests for coeliac disease markers, including serum anti-tissue transglutaminase antibodies (anti-tTG), anti-gliadin antibodies (AGA IgG an AGA IgA), anti-endomysium antibodies (EMA), and human leukocyte antigen (HLA)(DQ2/8). The Student *t* test, the Mann-Whitney test, and ANOVA with Bonferroni correction were utilized to evaluate the differences among means. A high percentage of abnormal IPT values were found among patients with autism (36.7%) and their relatives, (21.2%) compared with normal subjects (4.8%). The percentage of abnormal values of patients with ASD and their relatives were significantly different from those of the respective control groups (Fisher exact test, $p < 0.0001$). Small intestine barrier function was more deregulated in children with ASD with regular eating habits, than in those who were on a GFCF diet ($p = 0.034$, Mann-Whitney test). GI symptoms were present in 46.7% of children with autism: constipation (45.5%), diarrhea (34.1%), and others (alternating diarrhea/constipation, abdominal pain, etc., 15.9%). Measuring IPT, and thus utilizing it as a biomarker could help to identify a subgroup of patients with autism who could benefit from a gluten-free diet. A genetic factor may be present in influencing the intestinal

barrier, due to the finding that a large number of first-degree relatives showed IPT impairment also. In conclusion, IPT was abnormal in a subgroup of children affected by ASD and thus, the leaky gut hypothesis was supported.

In summary, children with ASD tend to experience some of the following nutrition-related factors, increased food avoidance behaviors, more problematic mealtimes, and higher rates of repetitive behaviors and sensory differences. Children with ASD also tend to experience more GI problems, including intestinal permeability abnormalities. Thus, nutritional deficiencies could occur as a result of some of these nutrition-related factors, posing a threat to optimal growth and development.

Diet Quality of Children

Kim et al. (2014) described trends in the contributions of fruits and vegetables to the diets of children aged 2-18 years. Eating more fruits and vegetables increases nutritional adequacy of diets, reduces the risks for leading causes of illness and death, and helps manage body weight. The Centers for Disease Control and Prevention (CDC) analyzed 1 day of 24-hour dietary recalls from the National Health and Nutrition Examination Surveys from 2003 to 2010 to estimate trends in children's fruit and vegetable intake in cup-equivalents per 1,000 calories (CEPC) and trends by sex, age, race/ethnicity, family income to poverty ratio, and obesity status. Total fruit included whole fruit (all fruit excluding juice) and fruit juice (from 100% juice, foods, and other beverages). Total vegetables included those encouraged in the *Dietary Guidelines for Americans, 2010* (i.e. dark green, orange, and red vegetables and legumes), white potatoes, and all other vegetables. To examine trends in fruit and vegetable intake, average annual change in CEPC per year was calculated using linear regression and was reported as a percent. T-tests were used to

examine differences in fruit and vegetable subgroups by socio-demographic characteristics in 2009-2010. A p-value of <0.05 was considered statistically significant. Total fruit intake among children increased from 0.55 CEPC in 2003-2004 to 0.62 in 2009-2010 because of significant increases in whole fruit intake (0.24 to 0.40 CEPC). Over this period, fruit juice intake significantly decreased (0.31 to 0.22 CEPC). Total vegetable intake did not change (0.54 to 0.53 CEPC). No socio-demographic group met the *Healthy People 2020* target of 1.1 CEPC vegetables, and only children aged 2-5 years met the target of 0.9 CEPC fruits. In conclusion, children's total fruit intake increased because of increases in whole fruit consumption, but total vegetable intake remained unchanged.

Hyman et al. (2012) conducted a study to characterize the nutritional intake of children with ASD, and to assess the impact of reported food aversions and restricted diets. A sample of 367 children aged 2-11 years were recruited from Autism Treatment Network sites to participate in this study. Parents of these children completed a 3-day food record containing all food, beverage, and supplements ingested by the child over 3 consecutive days including 1 weekend day. Body mass index (BMI), BMI-for-age percentile, and history of dietary restrictions were collected. This information was compared with both the NHANES data and a matched subset based on age, gender, family income, and race/ethnicity. T tests were utilized for continuous variables (nutrient intake), while Chi Square tests were utilized for categorical variables (BMI category). Children with ASD aged 2 to 5 years were more likely to be overweight ($p < .05$) or obese ($p < .001$), than the NHANES matched cohort. The analyzed food records had a sample of 252 participants. Children with ASD aged 4-8 years consumed less energy, a lower percentage of protein, and a greater percentage of carbohydrates on average, than the NHANES (2007-2008) matched sample. Children with ASD identified lower than recommended intakes on vitamins A,

D, and K, as well as calcium, choline, fiber, magnesium, phosphorus, and potassium from food sources. The percentage of children with nutrient intake less than the estimated average requirement (EAR) increased with age for vitamins A, C, E, B12, and folate, and the minerals zinc and magnesium. Many children with ASD had nutrient intakes above the tolerable upper intake level (UL) from food alone such as copper, retinol, folic acid, zinc, and manganese. Elevated sodium was seen for all age groups studied. Primary care for all children should include nutritional surveillance and attention to BMI. In conclusion, children with and without ASD consumed less than the recommended amounts of certain nutrients from food.

Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela (2015) conducted a study to compare intakes of macro and micronutrients, and BMI in children with ASD and TD children. A total of 40 children (35 boys and 5 girls) agreed to enroll in the study and their results were compared to a matched group of 113 TD children (63 boys and 50 girls). All children were between the ages of 6 and 9 years, and living in the same area. Three-day food diaries and anthropometric measurements were completed for all children in this case-control study. Children with ASD had a statistically significant lower BMI than the TD children ($p = 0.02$), determined via Chi Square. Compared to TD children, Wilcoxon rank sum test indicated children with ASD had consumed significantly less fluoride ($p = 0.02$) and more vitamin E ($p = 0.001$), which are compatible with a low intake of fish and high intake of sunflower and corn oil respectively. Most children in both groups failed to meet recommendations for carbohydrates and fiber, with intakes lower than the recommended dietary intakes (RDIs). On the other hand, lipids and cholesterol were consumed in excess by all children, but more particularly by TD children. Inadequate intakes of vitamin D, calcium, and iron were more frequently consumed by ASD children than TD children. Children with a limited

range of accepted foods may indicate a need for interventions involving dietitians and other specialists to encourage the consumption of a greater variety of foods. In conclusion, since children with ASD exhibit limited variety and inadequacy of some nutrients, routine monitoring of ASD children should include an assessment of their dietary habits along with anthropometric measurements.

Zimmer et al. (2012) conducted a study to investigate whether children with autism were more likely to be selective eaters, and whether selective eating among children with autism placed them at an increased risk for nutritional deficiency. The participants of the study ($n = 44$) included 22 children with autism and 22 unrelated age matched (+/- 1 year) TD children. There were predominately males in the autism group (91%) compared to the controls (45%). Dietary intake was measured via a food frequency questionnaire, while the nutritional status was measured via BMI. Wilcoxon Rank Sum Tests were utilized to compare food variety scores of children with autism to their matched controls, while the Chi Square analyses and Fisher exact tests were utilized to determine whether the proportion of children meeting or not meeting the DRIs were different between groups. Statistical significance was set at a two tailed alpha $p < .05$. Children with autism tried a mean of 33.5 foods per month, while TD children tried a mean of 54.5 foods per month ($p < .001$). Compared with TD controls, children with autism had a higher average intake of magnesium ($p = .02$), and a lower average intake of protein ($p = .01$), calcium ($p = .01$), vitamin B12 ($p = .01$), and vitamin D ($p = .005$). Selective eaters with autism had a significantly lower average intake of protein ($p = .01$), calcium ($p < .001$), vitamin A ($p = .02$), vitamin B12 ($p = .01$), and vitamin D ($p < .001$) than TD controls. Selective eaters with autism were more likely than typical controls to be at risk for inadequate intake for calcium ($p = .001$), zinc ($p = .03$), vitamin B12 ($p = .03$), and vitamin D ($p = .001$). Selective eaters with autism were

significantly more likely than TD controls to have inadequate intake of at least one nutrient ($p = .03$). Similarly, Attlee, Kassem, Hashim, & Obaid (2015) observed that children with ASD were at an increased risk for nutritional deficiencies compared to children without developmental delays. Future studies are needed to validate food variety as a risk for nutrient intake deficiency and establish the range and severity of risk of these deficiencies among children with autism. In conclusion, selective eaters with autism may be at a greater risk for inadequate nutrient intake compared to non-selective eaters with autism and a control group. Additionally, food variety was significantly lower among children with autism than typically developing children.

Graf-Myles et al. (2013) conducted a study to compare children with autism (AUT) to both typically developing (TYP) and developmentally delayed children without ASD (DD) on nutrient intake, food group intake, overall diet quality, and to evaluate the impact of diet restriction. The participants of the study ($n = 120$) included 69 children with autism, 14 children with developmental delays, and 37 typically developing children. In each of the subgroups, the participants were predominately male. Caregivers of children aged 1-6 years were asked to complete a 3-day food record for their child and to report data on intentional diet restriction. Other measures included blood samples and the Short Sensory Profile (SSP). To partially correct for the large number of tests, significance was set to $p = 0.01$. ANOVA was used to determine differences amongst the diagnostic groups on macronutrient and micronutrient intake. The DD and AUT group both were significantly less likely to consume adequate calcium compared to the TYP group. After subjects with restricted diets were excluded, the AUT group still consumed significantly less calcium ($p = 0.001$) and vitamin D ($p = 0.001$) than the TYP group. As with the analyses in the full sample, only calcium was of clinical significance ($p < 0.001$). The AUT group consumed significantly higher percent of calories from

monounsaturated fats compared to the TYP group. Children in the AUT group consumed significantly less vitamin A, vitamin D, riboflavin, folate, and calcium than the TYP group. However, only group differences on calcium were associated with inadequate intake. The AUT group was significantly less likely to consume at least 100% of recommended dairy servings, and more likely to consume at least 100% of recommended protein servings, than the TYP group. The DD group was less likely than the TYP to consume at least 100% recommended grain servings. Children with autism on a restricted diet had significantly lower folate intake and a higher prevalence of inadequate folate intake than those not on a restricted diet, consistent with less intake of grains. Children in the AUT group not following a restricted diet received significantly worse Healthy Eating Index-2005 scores than those following a restricted diet and TYP. All groups had inadequate fiber, vitamin D, and vegetable intake. Future studies should focus on evaluating the dietary effects of selective eating, utilizing more direct measures of food selectivity. In conclusion, dietary compensation is necessary for children with autism on GF and/or CF diets, as the differences between the AUT and TYP group in this study could mostly be explained by the large proportion of children with autism on restricted diets without adequate substitution of other dietary sources to obtain these nutrients. Special dietary considerations for children with autism include obtaining adequate calcium, folate, dairy, and grains.

In summary, all children within the U.S. tend to fall short of meeting the dietary recommendations for fruit and vegetable consumption. Since children with ASD tend to exhibit more selective eating patterns, ensuring adequacy within the diet may be especially necessary within this particular population. A few special nutrient considerations for children with ASD include calcium, dairy, folate, and grains. If children with ASD are on a gluten-free and/or

casein-free diet, adequate substitution from other dietary sources may be necessary to prevent nutrient deficiencies.

Complementary and Alternative Medicines (CAMs)

Barnes & Bloom (2008) describe CAM as covering a heterogeneous spectrum of ancient to new-age approaches that purport to prevent or treat diseases. They reported selected estimates of CAM use among U.S. adults and children, using data from the 2007 National Health Interview Survey (NHIS), conducted by the CDC National Center for Health Statistics (NCHS). Results from the 2007 NHIS found that approximately one in nine children (11.8%) used CAM therapy in the past 12 months, with the most commonly used therapies being non vitamin, non mineral, natural products (3.9%) and chiropractic or osteopathic manipulation (2.8%). Children whose parent used CAM were almost five times as likely (23.9%) to use CAM as children whose parent did not use CAM (5.1%). In 2007, adults and children who reported a delay in receiving conventional care due to the concern of cost were more likely to use CAM compared to when cost was not a concern. The characteristics of adult and child CAM users are similar – for example, education, poverty status, geographic region, the number of health conditions, the number of doctor visits in the last 12 months, and delayed or not receiving conventional care because of cost have all been found to be associated with CAM use. The NHIS identified non-Hispanic origin, higher education of the parent, higher income (poverty status), not living in the South, and having a usual place of care were associated with a child's use of CAM.

Perrin et al. (2012) conducted a study to examine the associations of CAM use with diagnostic categories of ASD, co-occurring conditions including other mental health conditions, and use of other treatments. Participants in the study (n = 3,173) included 2,671 males (84%) and

502 females (16%). Parents of children aged 2-18 years were asked to complete a medical history questionnaire, the Child Sleep Health Questionnaire (CSHQ) in children <11 years of age, and the Child Behavior Checklist (CBCL). Logistic regression was utilized in order to determine associations of diagnostic category, other medical conditions, and medication use with CAM treatments. Prevalence odd ratios (ORs) and 95% confidence intervals were utilized to describe the association between the use of any CAM, special diets, or other CAM and the risk factors relative to the control group of no CAM usage. Statistical significance was set at $p \leq .05$. A total of 896 (28%) participants reported use of any CAM; 548 (17%) reported use of a special diet; and 643 (20%) reported use of other CAM treatment. Children and adolescents with a diagnosis of Asperger's or Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) had significantly decreased use of any CAM compared with children with a diagnosis of autism (Aspergers OR = 0.62 and PDD-NOS OR = 0.66). Those with PDD-NOS or Asperger's had significantly lower reports of use of special diets than those with autism (ORs = 0.44 and 0.65, respectively). Those with PDD-NOS had significantly lower reports of use of other CAM than those with autism (OR = 0.67). Parents of children in the Autism Speaks Autism Treatment Network (ATN) registry reported significantly higher rates of CAM use when they also reported GI problems (OR = 1.88 for CAM use in general; OR = 2.38 for special diets; OR = 1.82 for other CAM). Children whose parents reported a history of seizures also reported higher CAM use (OR = 1.58 for CAM use in general; OR = 1.97 for special diets; OR = 1.664 for other CAM). Children with CBCL scores (total) above the cutoff of 70 had significantly higher rates of CAM and special diet usage than children with lower scores (OR = 1.29 for CAM; OR = 1.34 for special diets). Children with reported psychotropic medication use had significantly lower current use of special diets (OR = 0.69). Future studies should include confirmatory information

from other observers or measures of the child's findings or health status instead of all information solely coming from parent report. In conclusion, children with ASD utilize more CAM when they have co-existing GI symptoms, seizure disorders, and behavior problems. Similarly, Mulloy et al. (2010) supports that a GFCF diet should be implemented in the event that a child with ASD experiences acute behavioral changes that appear to be associated with diet changes, and/or medical professional confirmation through testing of food intolerances/allergies to gluten and/or casein.

Goin-Kochel, Mackintosh, & Myers (2009) conducted a study to extend previous work by providing parental ratings of efficacy for both biological treatments and behavioral/educational therapies. The participants (n = 479) were caregivers/parents of children with ASD and the majority of these caregivers were mothers (91%). The children's average age at the time of the survey was 8.3 ± 4.3 years. More than half (59.7%) of the children had autism, 23.6% had Asperger syndrome, and 16.7% had PDD-NOS. Parents were asked to complete an online questionnaire that focused on various aspects of their children's development of ASD and families' experiences with having a child with ASD. One section of this questionnaire specifically focused on parents' efficacy ratings for the medications and diets ever tried by children in an open-ended format. The most frequently tried medication/diet treatments were stimulants (172 reports), the GFCF diet (155 reports), and antidepressants (136 reports). Improvements combining "dramatic" and "somewhat," were rated by parents for 50-80% of children in each of the 9 drug categories. Ratings of "child became worse" were generally low, but were notable for antidepressants (16.2%), atypical antipsychotics (18.8%), mood stabilizers (17.1%), and stimulants (20.3%). Dietary interventions were rated as effective (either "dramatic" or "somewhat") by about half of those who used them. For the GFCF diet, just over half (51%)

endorsed improvements, about one-fourth saw “no noticeable effect” and about 10% reported their “child became worse.” For the “other diets,” about half saw improvements and about one-third saw no noticeable effect. Examples of other diets included vegetarian, Feingold diet, avoidance of red dyes, and avoidance of sugar. Future studies should more specifically ask parents about the actual effects they observed while their children were on various treatments, asking parents to note which specific behaviors changed or remained unchanged. In conclusion, parents in this large-sample survey generally believed that most treatments and therapies they had tried displayed some degree of improvement for their child with ASD.

Şenel (2010) conducted a study to discover the type of CAM treatments that Turkish parents of children with ASD used, along with corresponding experiences and views of each treatment. The rating of each CAM treatment, effect, perceived positive changes or improvements post-CAM treatments, and negatives seen in response to these treatments were obtained. A survey was sent and completed by 38 parents in regards to their children with ASD. The majority (82%) of these children were male; 68% of the parent respondents were mothers. Results indicated that “Vitamins and minerals” (32 tried) followed by “Special Diet” (30 tried) were the most frequently used CAM treatments by parents. Other dietary supplements were the fourth most commonly used CAM treatment after sensory integration. The main improved areas in response to the five most frequent CAM treatments were communication, learning, health, and behavior. Communication improved immensely for vitamins and minerals and other dietary supplements, while - “sleeping”-and- “eating”- improvements were reported for vitamin and mineral usage. The average number of CAM treatments tried by parents was 5. Future studies should include a larger sample size with more physical contact to possibly increase the response rate of these surveys. Additionally, a meta-analysis should be considered for analyzing the

studies related with these treatments and to research details of negative effects associated with any of the CAMs through a large sample of parents. In conclusion, “Vitamins and minerals” and “Special Diet” were the most highly utilized and perceived as being highly beneficial CAM treatments by parents of children with ASD. Parents of children with ASD are often searching for a way to improve their child’s life or the parents do not want to deprive their child of the possible benefits that a CAM treatment could bring. However, there was no one CAM treatment that displayed 100% improvement without negative sides such as being expensive, difficult to apply, or even harmful.

Winburn et al. (2014) conducted a study to investigate parents’ and professionals’ experience of dietary interventions and attitudes towards a proposed trial to evaluate the GFCF diet. The participants of the study (n = 502) included 258 UK parents of children with ASD and 244 child health professionals working with children with ASD. The children were predominately male, as the male to female ratio was 4:1 and the age of survey completion of children was predominately 6-11 years of age (67%). The parents and health professionals were each asked to complete their respective questionnaires, which were both offered via paper and electronic means. The questionnaires included four sections: 1) demographic characteristics; 2) experience and use of interventions for treatment of ASD in young children; 3) research priorities; and 4) a final section contained a summary description (‘vignette’) of the design for a proposed double-blind, multi-site randomized controlled trial (RCT) to evaluate the impact of GFCF diet in young pre-school children with ASD together with an illustrative flow chart. Twenty-six percent of professionals (mostly Pediatric Dietitians and Pediatricians) reported that 10-20% of the children with ASD they see are utilizing the GFCF diet. Results indicated 83% of the parents had tried a range of dietary manipulations (including any special diet and use of

dietary supplements) with their child. 35% were currently utilizing a special diet and 46% were currently utilizing dietary supplements. For the 76 children currently on the GFCF diet, most parents reported a change in their child's behavior with 'significant improvements' most frequently reported for GI symptoms (54%). Other symptoms reported to 'significantly improve' were concentration and attention (42%), communication (29%), social interaction (25%), and repetitive interests and behaviors (20%). Seventy-three percent of professionals stated that there was 'insufficient evidence about the benefits or otherwise' of the GFCF diet. Parents were more likely to agree to take part in the proposed RCT if they were not currently implementing the GFCF diet for their child ($\chi^2 = 11.670$, $df = 2$, p = <0.01). Considering the trial protocol, 77% of parents thought there was sufficient dietitian support and this was significantly associated with likelihood to take part ($\chi^2 = 30.539$, $df = 2$, $p < 0.001$). Reducing the duration of the GFCF diet protocol to 3 months might have been more acceptable to parents and professionals when participating in a RCT. In conclusion, most parents of children with ASD who responded to this UK survey utilized a variety of interventions (most frequently speech/communication, educational and a mixture of dietary manipulations) and were usually implementing a variety of interventions or strategies at the same time. There was general agreement from both parent and professional respondents for the need for more information about, and for more research on, a range of interventions including dietary supplements and the use of 'special' diets. Both parents and health professionals would be prepared to consider taking part in a proposed RCT design to evaluate the GFCF diet.

Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales Suárez-Varela (2016) conducted a study to investigate the anthropometric and nutritional status of a group of children with ASD on a GFCF diet. The participants of the study (n = 105) included 20 children

with ASD (17 boys and 3 girls) on a GFCF diet for less than 3 months and 85 children with ASD (76 boys and 9 girls) on a regular diet. Parents of children aged 6-9 years were asked to complete food diaries spanning 3 days, with the inclusion of one non-working day. Anthropometric measurements of weight and height were also obtained for these children. The Student's *t* test was utilized to compare anthropometric values, and nutritional intake in children with ASD on a GFCF diet and those on a regular diet. Contingency tables, odd ratios, and Chi-Squared test were utilized to assess statistical significance for inadequacy of the diet in relation to the recommended intake. Statistical significance was set at $p < 0.05$. Children with ASD on the GFCF diet were more likely to have a lower weight ($p = 0.03$), BMI ($p = 0.004$), BMI z-score ($p = 0.001$) and total energy intake ($p = 0.03$) than children with ASD on a regular diet. Children with ASD on a GFCF diet ate significantly less pantothenic acid, calcium, and phosphorus. However, these children ate significantly more legumes, vegetables, fiber, iron, and magnesium. The ratios of PUFA + MUFA/SFA and PUFA/SFA were better compared to children on a regular diet, and the intake of SFAs and sodium were lower. Children in both groups consumed too little fluoride and children on a regular diet consumed significantly more than the recommended amount of total fat and SFAs. In order to be able to determine the effects of the GFCF diet, future research with larger sample sizes that includes double-blind, long-term randomized controlled trials are needed. In conclusion, the anthropometric results were consistent with the nutritional intake observed in children with ASD on a GFCF diet. Additionally, vitamin D and calcium supplementation may be warranted since vitamin D intake was deficient in both groups of children and those on the GFCF diet failed to meet calcium intake recommendations.

Pennesi & Klein (2012) conducted a study to examine ASD subpopulations and diet implementation factors related to the GFCF diet. Parents/primary caregivers of children with ASD (n = 387) completed a 90-item online questionnaire. The 90-item questionnaire inquired about their child's GI symptoms, food allergy diagnoses, suspected food sensitivities, and GFCF diet trial compliance and length. Eighty-two percent (n = 315) of the children with ASD were males and 88.9% (n = 330) were Caucasian. Parents who eliminated all gluten- and casein-containing foods (n=223) and experienced infrequent diet errors during and outside of parental care reported that a greater number of their child's ASD behaviors, physiological symptoms, and social behaviors improved post implementation of this GFCF diet ($p < 0.05$). Additionally, the GFCF diet was effective in improving ASD behaviors, physiological symptoms, and social behaviors for children with GI symptoms of diarrhea and constipation in particular, suspected food sensitivities, and food allergy diagnoses compared to children whose parents reported none of these symptoms, sensitivities, or diagnoses ($p < 0.05$). The GFCF diet was found to be less effective in providing improvements in children when implementation was for 6 months or less in comparison to all other groups ($p < 0.01$). These results were found via one-way analyses of variances and Tukey's B *post hoc* analyses; all tests were two-tailed. It is critical that future experimental studies determine specific subpopulations of children with ASD that may benefit from a strictly followed GFCF diet and confirm this study's findings. In conclusion, some children with ASD may benefit from the implementation of a GFCF diet, especially if the child has GI symptoms, food sensitivities, or food allergies. However, the diet should be implemented for more than 6 months and should be strictly adhered to in order to aid in determining diet efficacy.

In summary, the GFCF diet is a common CAM in relation to diet utilized by children with ASD. Since various CAMs are often being used at the same time, it has been difficult to pinpoint the effects of a GFCF diet. However, the GFCF diet has been shown to be beneficial for some children with ASD when implemented for a substantial period of time, especially if the child has GI symptoms, food allergies, or food sensitivities. Additional research is needed to validate the effectiveness of the GFCF diet in children with ASD.

Nutrition Education Camps

Muros, Zabala, Oliveras-López, Ocaña-Lara, & de la Serra (2013) conducted a study to determine the effect of nutrition education given to children and parents combined with sessions of vigorous extracurricular physical activity (VEPA). During this 7-week program, the improvement of health related parameters in primary education students in southern Spain was determined. The participants of the study (n = 54) included students (10-11 years) in fifth-year classes. Twenty-five children (15 boys and 10 girls) were in the intervention group, while 29 children (10 boys and 19 girls) were in the control group. Results indicated that 27.59% and 36% of children presented as being overweight or obese in the control and intervention group respectively. Pre and posttest measures were utilized to provide a comparison between the control group (CG) and the intervention group (IG). The IG participated in physical activity and nutrition education sessions, while the CG did not participate in either of these. Variables measured at pre and posttest included aerobic capacity, anthropometric data, blood chemistry, blood pressure, dietary changes, and healthy habits survey. T test or Wilcoxon test were utilized for two related samples comparing the variables of aerobic capacity, blood composition, blood pressure, and dietary changes. The Chi-Squared parameter or the McNemar test were utilized to

evaluate the changes produced in the results of the Krece Plus test and to compare two categorical variables. The level of significance was set at $p < 0.05$. For maximal oxygen uptake, the IG showed significant ($p < .01$) improvement after treatment and at posttest; values were significantly higher in the IG relative to the CG (45.95 ± 4.26 ml/kg/min VS. 43.25 ± 3.29 ml/kg/min). BMI increased significantly only in the CG ($p \leq .01$) and the comparison of posttest values between the CG and IG indicated that the IG exhibited a significantly lower fat percentage ($p \leq .05$). Diastolic blood pressure (DBP), total cholesterol (TC) ($p < .05$) and cLDL ($p < .01$) measured at posttest were significantly lower in the IG relative to the CG. Dietary intake in a 72-hour regimen indicated that at posttest, the IG showed significant reductions in cholesterol, however levels remained higher than values stated by the recommendations ($p \leq .01$). At posttest, the IG showed increased levels of physical activity relative to pretest ($p \leq .01$). Posttest values regarding the dietary variable were significantly better in the IG relative to the CG ($p \leq .05$). Since the intervention consisted of various components; exercise, nutritional education and lifestyle education, independent effects of each are unable to be determined. In conclusion, the results of this study provide evidence that a 7-week program incorporating vigorous short-duration physical activity and a nutritional education component carried out at school can improve health-related parameters in children.

Hu et al. (2010) conducted a study to evaluate the effectiveness of nutrition education in kindergartens and to promote healthy dietary habits in children. The participants of the study ($n = 2,068$) at baseline included 1,237 children in the intervention group (IG) and 831 children in the control group, all aged between 4 and 6 years. Children and parents in the intervention group participated in nutrition education activities. The main outcome measures were anthropometrics and diet-related behaviors of the children and the nutritional knowledge and attitudes of the

parents at baseline (pre-test), 6 months (mid-term), and 1 year (post-test). The Student *t* test and repeated-measures analysis were both utilized for statistical analysis, with statistical significance set at $p < 0.05$. Compared with controls, the prevalence of children's unhealthy diet-related behaviors (unhealthy snacks, monotonous diet, adult assistance during meals, playing during dinner, watching TV during dinner) decreased significantly and good lifestyle behaviors (eating breakfast, taking part in outdoor activities, helping with household duties) increased in the group that received nutrition education ($p < 0.05$). Nutritional knowledge among IG parents increased significantly during the follow-up period ($p < 0.05$). Parental eating habits and attitudes to planning their children's diet also changed appreciably in the intervention group compared to the control group ($p < 0.05$). In conclusion, kindergarten-based nutrition education improved preschoolers' lifestyle behaviors and brought about beneficial changes in parents' attitudes to planning their children's diets and their own personal eating habits.

Ghanizadeh & Haddad (2015) conducted a study to determine the effectiveness of the overall dietary intervention rather than a single nutrient on children with ADHD. The participants of the study included 85 children with ADHD aged 5 to 14 years in Iran that completed the duration of the intervention, which was one month. Anthropometric measurements and dietary intake via FFQ were collected. One group received methylphenidate with dietary recommendations, while the other group only received methylphenidate. The ADHD DSM-IV checklist was utilized to assess inattentiveness and hyperactivity/impulsivity scores at baseline and at the end of the trial. A chi-squared test was utilized for categorical variables, *t*-test was utilized to compare continuous variables, and linear regression analyses were performed during the second round of statistical analyses. Statistical significance was set at $p < 0.05$. A significant negative correlation was observed between the inattentiveness scores at the end of the trial and

the mean change of favorite diet scores ($p < 0.03$). A couple of limitations of this study included a small sample size and relatively short intervention duration. In conclusion, encouraging children with ADHD to increase their intake of recommended diet markedly improves their attention. An un-favorite diet (foods recommended to be eaten as less as possible) had no effects on inattentive or hyperactivity/impulsivity score.

In summary, nutrition education programs of various durations (7 weeks, 1 month, and 1 year) have been shown to be effective and beneficial in typically developing children and children with ADHD. Nutrition education programs of at least 7 weeks should therefore be beneficial for children with ASD in order to help them overcome monotonous dietary patterns. There is little to no evidence displaying the effectiveness of nutrition education in children with ASD. Additionally, it is common to find nutrition education and physical activity programs paired together. Thus, making it difficult to attribute specific benefits to nutrition education, physical activity, or both.

Summary

ASD is a neurodevelopmental disorder whereby repetitive behaviors and strict adherence to daily routines are often seen. The growing prevalence of ASD is significantly higher amongst boys in comparison to girls. There are various dietary-related considerations that place children with ASD at a potentially higher risk of nutritional deficiencies, hindering optimal growth and development. Such dietary-related considerations include, but are not limited to, avoidance of new foods, limited variety of eating patterns, selective eating patterns, mealtime behaviors and GI symptoms. The diet quality of all children tend to fall short of meeting the dietary recommendations for fruit and vegetable consumption. Children with ASD have special nutrient

considerations such as dairy, calcium, folate, and grains, to name a few. If a child with ASD is on the GFCF diet, which is a common diet-related CAM for these children, substitutions may be necessary for nutritional adequacy. Nutrition education has been found to be beneficial in typically developing children and children with ADHD. Thus, although there is little to no nutrition education research on children with ASD, benefits should also be seen with this population. Nutrition education may be especially necessary for some children with ASD to ensure optimal growth and development especially due to their aversion to change.

CHAPTER 3

METHODOLOGY

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data. This chapter will describe the methods used to conduct the study.

Institutional Review Board

Permission was granted by the Ball State University Institutional Review Board (IRB) prior to implementing the intervention (the nutrition education program) (Appendix A-1). The initial IRB approval was modified by the Ball State University Institutional Review Board, adding this researcher to the protocol and allowing this researcher to access and analyze the data initially collected from this study (Appendix A-2). In addition, this researcher completed the Collaborative Institutional Training Initiative training (Appendix A-3).

Subjects

The population for this study included a convenience sample of children with ASD who were enrolled at a Midwest Summer Day Camp for Children with ASD. The estimated total

number of participants and their children (6-12 years) who initially agreed to partake in this study was 30-40.

Instruments

A FFQ, created by the original researchers (the two registered dietitians – JK & AH), was completed by the parents of the campers the week before the beginning of camp, during the fifth (last) week of the camp, and one-month post camp (Appendix B). Two registered dietitians who participated in the study developed the FFQ based on their previous research surrounding the eating habits of children with and without ASD. Expert content validity based on five professional registered dietitians (RDs) was conducted on this FFQ. Reliability information was not provided.

Letters of Consent

Informed consent was provided by the parents of children with ASD who attended the camp. The consent form provided an overview of the study and answers to potential questions that parents may have had regarding the study (Appendix C-1). In addition to the informed consent form, the parents were asked to sign a parental consent form (Appendix C-2). This form described the same information that was on the informed consent form. However, this form documented that the parents were giving their permission to allow their children to participate in the study. If parents reported that their child would understand the assent process if it was explained to them by one of the key personnel, the child was asked to provide an assent form, and thus agreed to participate in the study (Appendix C-3).

Methods

Prior to the start of camp, two RDs trained RD eligible students whom assisted on data collection related to the assessment of children's dietary consumption at lunch time. JK and AH were extensively involved in the nutrition section of the project. Parents/legal guardians of campers met with camp staff the week before camp began. The RDs informed the parents about a nutrition study. If parents were interested, one of the key personnel met with the parents during their time with staff and reviewed the consent process. Parents who provided consent (Appendix C-1) were shown the assent form (Appendix C-2) and asked if they thought their child could understand the assent process if it was explained to them by one of the key personnel. Children whose parents reported that their child understood the assent process were asked to provide assent (Appendix C-3).

As noted in Figure 1, the duration of the research study was for 10 weeks and consisted of six parts. Part 1 – week 1 prior to camp included completion of a food frequency questionnaire (FFQ) by parents of the campers one week prior to the start of camp (pre-test). Part 2 – week 2 consisted of observing and recording what was included and consumed in the participants' lunches during the first week of camp. Part 3 – week 4 encompassed teaching nutrition education to parents for one-hour during the third week of camp. Part 4 – week 6 included completion of the same FFQ by parents of the campers and observing and recording what was included in the participants' lunches during the fifth week of camp. Part 5 – weeks 7 – 9 consisted of communication between parents and the RDs regarding nutrition-related questions between the end of the camp and one-month post camp. Lastly, part 6 – week 10 included a follow-up FFQ one-month post camp administered to parents of the campers.

Figure 1. Duration of the Research Study Summary

Part 1 **Week 1**	**Part 2** **Week 2**	**Part 3** **Week 4**	**Part 4** **Week 6**	**Part 5** **Weeks 7-9**	**Part 6** **Week 10**
Completion of FFQ by parents	Observing/ recording lunches	One-hour nutrition education	Observing/recording lunches; Completion of FFQ by parents	Parent-RD conversation	Completion of FFQ by parents

During the first week of camp (all 5 days), the student assistants worked with one of the two RDs to record the foods in each of the participating children's lunches before and after lunch. Subsequently, the percent of each food item consumed by the child during the lunch period was recorded. During the third week of the camp, a one-hour nutrition education session tailored to parents of children with ASD was provided to participating parents by the two RDs. Two separate sessions were offered throughout the day (morning and afternoon sessions), which included taking questions as they arose in the first half, and discussing with the participants in the second half of the session. Information on food groups, portion sizes, and ASD specific diets, as well as applicable tips and strategies to help improve the nutritional intake of children with ASD was provided (Appendix D). Also, all parents, regardless of whether or not they participated in the nutrition education session, were provided print nutrition educational materials on the same topics discussed. During the fifth week of camp (all 5 days), student assistants, with the RDs, recorded the foods in each of the participating children's lunches, as well as the percent of each food item consumed during the lunch period, just as in the first week. Additionally, during the fifth week, parents were asked again to complete a brief FFQ about their child's current dietary intake (post-test).

After camp ended, the parents were contacted once or twice via telephone or email to see if they had any nutrition-related questions. One-month after the camp, the parents were emailed a

link to an electronic version of the brief FFQ (using Qualtrics) to complete one last time. To encourage completion, participants were contacted via telephone by key personnel encouraging parents' completion of the FFQ via Qualtrics survey. Parents were provided one week to complete the survey.

Data Analysis

All data was entered into a Microsoft Excel spreadsheet prior to being uploaded to SPSS. Data was analyzed using SPSS v.23 for Macintosh (SPSS, 2016). Once the data was collected, the names of parents and children were removed and replaced with codes to de-identify the electronic data. Descriptive statistics and frequency counts were run on all variables. Frequency counts (number and percent) were used to determine the overall prevalence of specific survey question responses among the study subjects. Analysis included changes in the frequencies of each food group consumed between the pre-test and post-test, between the post-test and one-month follow-up, and between pre-test and one-month follow-up. Additionally, the changes in the frequencies of each food group were provided in the child's lunches between pre-test and post-test were assessed. Friedman's 2-way ANOVA by ranks was used as a nonparametric test to test hypotheses regarding the children's intake. For the percent consumed, a paired samples t-test was utilized. To compare nutritional intake of the children participating in the study, two-way within-subject's ANOVA was utilized. Lastly, to compare nutrition by BMI, a three-way ANOVA with two within and one between-subject's factors was utilized. Statistical significance was set at $p \leq 0.05$.

Summary

This pre- and post-test research study was designed to improve the nutritional intake of children with ASD by providing applicable tips and strategies, along with education of portion sizes, food groups, and ASD specific diets to parents of children with ASD. Thirty children, between the ages of six and twelve years, attending a Summer Camp for Children with ASD in the Midwest United States, were recruited to participate in this study. The methods section included six parts of the study. These included a pre-test FFQ to parents, observation and recording of children with ASD lunches, providing a nutrition education intervention to the parents, a post-test FFQ given to parents while continuing to observe and record participants' lunches, contact parents regarding nutrition-related questions, and a follow-up FFQ administered via Qualtrics. Data from the FFQ and observation of food eaten during lunch was analyzed to determine the effectiveness of the nutrition education intervention administered to the parents of these children.

CHAPTER 4

RESULTS

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data. This chapter will describe the results of the study.

Subjects

A total of 21 children and their parents successfully completed the study. Both male (n=20) and female (n=1) children were included in this project, ranging in age from 6 to 12 years. The average age of the students enrolled at the summer camp was 8.76 ± 1.92 years. At baseline (week 1), the students had an average height of 54.40 ± 6.42 inches, ranging from 43 to 69 inches. The baseline weight ranged from 42 to 192 pounds, with an average weight of 95.29 ± 44.54 pounds. For BMI, the baseline average was 21.55 ± 5.80, while the baseline average BMI percentile was 80.34 ± 26.57. Table 1 depicts the frequency and percentage of children that fell within each BMI category. Most of the children were males (95.2%, *n*=20), while 4.8% (*n*=1) were females.

Table 1. Frequency and Percent of Children in Each BMI Category

BMI Category	Underweight	Normal	Overweight	Obese
Frequency	1	8	1	11
Percent (%)	4.8	38.1	4.8	52.4

Frequencies of Special Diet

At baseline (week 1), most children (85.7%, *n*=18) were not on a special diet. For the children reporting a special diet, all three reported using a gluten-free diet. In addition to being gluten-free, one also reported being casein-free as well as another, non-specified special diet. By the intermediate timeframe, most children were still not on a special diet (72.2%, *n*=13), but two additional children were reported to be on an unspecified special diet, bringing the total to 16.7% (*n*=3). In the final, follow-up survey 72.2% (*n*=13) of children were not on a special diet, with 27.8% (*n*=5) having either a gluten-free (*n*=3), casein-free (*n*=1), other special diet (*n*=3), or a combination of these diets.

Frequencies of Medication/Supplement Use

At baseline (week 1), 19.0% (*n*=4) of the children were not on medications or supplements, and 42.9% (*n*=9) reported usage of vitamin/mineral supplements. A prescription by the doctor was provided for 57.1% (*n*=12) of cases, while 19.0% (*n*=4) were over the counter medications. By the intermediate timeframe (week 5), 22.2% (*n*=4) were not on medications or supplements, and one less child reported usage of vitamin/mineral supplements (44.4%, *n*=8). A prescription by the doctor was provided for two fewer children (55.6%, *n*=10), while two more (33.3%, *n*=6) used over the counter medications. In the final, follow-up survey (week 9) 16.7% (*n*=3) of children were not on medications or supplements, and 55.6% (*n*=10) were on

vitamin/mineral supplements. A prescription by the doctor was provided for 61.1% (*n*=11) of cases, while 33.3% (*n*=6) were over the counter medications.

RQ#1: Changes in Food Group Consumption

The first research question analyzed changes in the number of food groups consumed per day by children with ASD between pre-test (week 1), peri-test (week 5) and post-test (week 9). As shown in Table 2, the number of times a child consumed a food at each time frame did not show changes for most items. However, using the Friedman's Two-Way Analysis of Variance by Ranks, there was a statistically significant difference in the frequency of sweets consumption (chocolates, candies, fruit snacks/gummies, cookies) each day by children with ASD ($x^2 = 6.75$, $df = 2$, $p = .034$). At baseline (week 1), the mean rank of the frequency in sweet consumption each day was 2.30, 2.00 at intermediate (week 5) and 1.70 at follow-up (week 9). This would indicate that the daily consumption of sweets was declining over time, as shown in Table 2 where daily consumption levels of 3 or more snacks decreased from 38.6% of the children at pre-test to 5.6% at follow-up. There was also a statistically significant difference in the frequency of snack consumption (potato chips, pretzels, cheese puffs) each day by children with ASD ($x^2 = 6.75$, $df = 2$, $p = .021$). At baseline, the mean rank of the frequency in snack consumption each day was 2.30, 2.00 at intermediate and 1.70 at follow-up. This would also indicate that the daily consumption of snacks was declining over time, as shown in Table 2 where daily consumption levels of 3 or more sweets decreased from 38.1% of the children pre-test to 5.6% at follow-up. There were no additional statistically significant differences in the daily consumption frequencies of food groups per day by children with ASD.

Table 2. Daily Consumption of Food Groups Pre-, Peri- and Post-Intervention

Food Item Eaten	Times Per Day	Pre-Test (Week 1)	Peri-Test (Week 5)	Post-Test (Week 9)
Fruits	0	5 (24%)	2 (9.5%)	4 (19.0%)
	1-2	11 (52.4%)	10 (47.6%)	10 (47.6%)
	3-4	5 (23.8%)	6 (28.6%)	4 (19.0%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Vegetables	0	6 (28.6%)	5 (27.8%)	6 (33.3%)
	1-2	13 (61.9%)	8 (44.4%)	9 (50%)
	3-4	2 (9.5%)	5 (27.8%)	3 (16.7%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Dairy Products	0	1 (4.8%)	2 (11.1%)	1 (5.6%)
	1-2	9 (42.9%)	4 (22.2%)	8 (44.4%)
	3-4	11 (52.4%)	10 (55.6%)	9 (50%)
	5-6	0 (0%)	2 (11.1%)	0 (0%)
Milk Alternatives	0	16 (76.2%)	15 (83.3%)	14 (77.8%)
	1-2	3 (14.3%)	3 (16.7%)	4 (22.2%)
	3-4	2 (9.5%)	0 (0%)	0 (0%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Meat	0	0 (0%)	0 (0%)	1 (5.6%)
	1-2	12 (57.1%)	10 (55.6%)	11 (61.1%)
	3-4	9 (42.9%)	8 (44.4%)	6 (33.3%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Other Protein Foods	0	5 (23.8%)	4 (22.2%)	3 (16.7%)
	1-2	14 (66.7%)	9 (50%)	14 (77.8%)
	3-4	2 (9.5%)	5 (27.8%)	1 (5.6%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Grains	0	0 (0%)	0 (0%)	0 (0%)
	1-2	4 (19.0%)	6 (33.3%)	5 (27.8%)
	3-4	14 (66.7%)	11 (61.1%)	10 (55.6%)
	5-6	3 (14.3%)	1 (5.6%)	3 (16.7%)
Sweets	0	1 (4.8%)	2 (11.1%)	2 (11.1%)
	1-2	12 (57.1%)	11 (61.1%)	15 (83.3%)
	3-4	7 (33.3%)	5 (27.8%)	1 (5.6%)
	5-6	1 (4.8%)	0 (0%)	0 (0%)
Fats	0	6 (28.6%)	4 (22.2%)	3 (16.7%)
	1-2	10 (47.6%)	10 (55.6%)	13 (72.2%)
	3-4	5 (23.8%)	4 (22.2%)	2 (11.1%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Fast Food	0	6 (28.6%)	4 (23.5%)	3 (18.8%)
	1-2	12 (57.1%)	12 (70.6%)	12 (75%)
	3-4	3 (14.3%)	1 (5.9%)	1 (6.25%)
	5-6	0 (0%)	0 (0%)	0 (0%)
Sweet Beverages	0	6 (28.6%)	4 (22.2%)	7 (38.9%)
	1-2	12 (57.1%)	11 (61.1%)	9 (50%)
	3-4	2 (9.5%)	3 (16.7%)	2 (11.1%)
	5-6	1 (4.8%)	0 (0%)	0 (0%)
Snacks	0	1 (4.8%)	1 (5.6%)	2 (11.1%)
	1-2	11 (52.4%)	12 (66.7%)	14 (77.8%)
	3-4	9 (42.9%)	5 (27.8%)	2 (11.1%)
	5-6	0 (0%)	0 (0%)	0 (0%)

RQ#2: Changes in Food Consumption

The second research question analyzed changes in food consumption of children with ASD after the administration of parental nutrition education during week three. Using a paired samples t-test, there was no statistically significant difference in the percent of food consumed after parental nutrition education was administered (t = .54, df = 20, p = .596). As shown in Table 3, the mean percentage of food consumed pre- (week 1) and post-intervention (week 5) was 71.62% and 69.61%, respectively. This would indicate that the total percent of food consumed by children with ASD during lunchtime at camp had not changed after the administration of the nutrition education intervention. Likewise, there was not a statistically significant difference in the number of food items consumed after parental nutrition education (t = -1.28, df = 20, p = .214). As shown in Table 4, the average number of food items consumed pre- and post-intervention was 4.61 and 4.80, respectively.

Table 3. Paired Samples T-Test Comparison for Percent of Food Consumed Pre- and Post-Intervention

	Mean	***SD***	***r***	***t***	***df***	***p***
Pre-intervention (Week 1)	71.62	17.77	.61	.54	20	.596
Post-intervention (Week 5)	69.61	20.32				

Table 4. Paired Samples T-Test Comparison for Food Items Consumed Pre- and Post-Intervention

	Mean	***SD***	***r***	***t***	***df***	***p***
Pre-intervention (Week 1)	4.61	.87	.71	-1.28	20	.214
Post-intervention (Week 5)	4.80	.88				

RQ#3: Changes in Nutrient Composition of Lunches

The third research question analyzed changes in the nutrient composition of home-packed lunches brought and consumed by children with ASD between baseline (week 1) and during camp (week 5) using separate two-way, within-subject's ANOVAs. The mean calories and nutritional measures of fat, protein, calcium, vitamin D, iron, and sodium for the lunches that were brought and consumed are shown in Table 5. With the exception of vitamin D ($F_{(1,20)}$ = 2.22, p = .152), all other measures showed differences between what was brought and consumed (all $p < .001$), meaning the children tended not to eat all the food that the parents prepared for their lunches. There were not statistically significant changes over time nor interactions, indicating that the lunches brought or consumed did not change from the baseline measures.

Table 5. Average Quantities of Macro- and Micronutrients Brought and Consumed by Children with ASD Pre- and Post-Intervention

	Brought		Consumed	
Nutrient	**Baseline (Week 1)**	**Intermediate (Week 5)**	**Baseline (Week 1)**	**Intermediate (Week 5)**
Calories (kcal)	681.36	669.04	478.83	446.68
Fat (g)	24.00	23.30	17.06	16.41
Protein (g)	19.60	18.39	13.59	12.49
Calcium (mg)	229.08	236.93	155.21	151.74
Vitamin D (IU)	18.27	23.53	14.23	17.60
Iron (mg)	3.30	2.99	2.30	1.89
Sodium (mg)	1,079.47	1,004.42	756.65	695.85

RQ #4: Changes in Nutrient Composition of Lunches by Child BMI

The last research question analyzed changes in macro- and micronutrient composition of the lunches brought to camp by BMI. Using separate three-way ANOVAs with two within (time and consumption) and one between-subjects factors (BMI category), there was a difference in what was brought compared to consumed by the children for all measures ($p < .001$) except vitamin D ($F_{(1,19)} = 3.00$, $p = .099$). No statistically significant differences were found for the main effects of time or BMI category, nor were there any statistically significant interactions. This indicated that the content of the lunch and what the children consumed did not change from baseline (week 1). It also indicated that the content of the lunch and consumption of lunches by

the underweight and normal BMI category of children did not differ significantly from the children classified as overweight or obese.

Table 6. Average Quantities of Macro- and Micronutrients Brought to Camp by BMI Pre- and Post-Intervention

	Underweight or Normal Weight (n=9)		Overweight or Obese (n=12)	
Nutrient	**Baseline (Week 1)**	**Intermediate (Week 5)**	**Baseline (Week 1)**	**Intermediate (Week 5)**
Calories (kcal)	661.14	697.37	696.51	647.80
Fat (g)	24.56	26.30	24.00	21.04
Protein (g)	20.41	19.25	19.00	17.75
Calcium (mg)	271.52	303.40	197.26	187.08
Vitamin D (IU)	32.30	45.71	7.75	6.90
Iron (mg)	3.35	3.37	3.27	2.70
Sodium (mg)	1,064.37	880.49	1,090.79	1,097.37

Summary

Of the children that attended the summer camp, 9 were classified as underweight or normal weight and 12 as overweight or obese. Results indicated a statistically significant difference in both the frequency of sweet and snack consumption per day by children with ASD between pre- (week 1), peri- (week 5) and post-test (week 9). The mean ranks of both the sweet and snack consumption indicated a declining trend. The total percent of food consumed and

number of food items consumed by children with ASD did not change after the intervention. Results also indicated that children tended to not consume everything that is packed in their lunch by parents. The nutrient composition of the lunches that were brought and consumed remained unchanged post-intervention. Lastly, the macro- and micronutrient content of the lunches were not significantly different among children with ASD by BMI category.

CHAPTER 5

DISCUSSION

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data. This chapter will discuss the results of the study.

Subjects

The present research included a study population that consisted mostly of males, between the ages of 7 and 11 years. This is similar to the prevalence of ASD being 4.5 times higher amongst boys in comparison to girls, both at the age of 8 years (Christensen et al., 2016). Over half of the children attending the summer camp had a BMI-for-age percentile that classified them as being obese. Similarly, Hyman et al. (2012) reported that children with ASD aged 2 to 5 years were more likely to be overweight or obese than the NHANES matched cohort. Although BMI was not calculated, Kral et al. (2015) also found similar results in that children with ASD had both significantly higher waist circumferences and waist-to-height ratios in comparison to TD children.

Various studies have supported the findings of children with ASD experiencing substantially more mealtime behavioral issues compared to TD children (Johnson, Handen, Mayer-Costa, & Sacco, 2008; Zobel-Lachiusa, Andrianopoulos, Mailloux, & Cermak, 2015). These problem feeding behaviors have been associated with a decrease in nutritional quality among children with ASD (Johnson et al., 2014). If some children with ASD tend to experience frequent eating behavior issues, this can hinder the quality of their nutritional intake. If the quality of nutritional intake is low, caloric intake is likely high. This may explain why over half of the subjects included in this study had a BMI-for-age classification of obese.

Special Diet

At baseline, children who reported being on a special diet, informed using a gluten-free diet. In addition to the gluten-free diet, one also reported being casein-free, and another reported a non-specified special diet as well. This is similar to the findings of Goin-Kockel, Mackintosh, & Myers (2009) in that the GFCF diet was the most frequently tried diet treatment amongst children with ASD within their particular study. Some special diets utilized by children with ASD that were not specified in this study include, but are not limited to, vegetarian, Feingold, avoidance of red dyes, and avoidance of sugar diets (Goin-Kochel, Mackintosh, & Myers, 2009). One of these diets could have been the non-specified diet that was being used by one of the children, in addition to the gluten-free diet. The majority of children participating in this study reported normal dietary practices.

Although this study did not assess whether the children had GI symptoms, food sensitivities, or food allergies, these factors could have better explained why parents did or did not place their child on a GFCF diet (Pennesi & Klein, 2012). Another factor to consider is CAM usage amongst parents of children with ASD. When comparing the use of CAM amongst

parents, the child is said to be nearly five times as likely to use CAM if their parent used CAM (Barnes & Bloom, 2008). This could also explain the frequencies of the GFCF diet within this study sample. Research has shown that children with ASD on the GFCF diet are more likely to have a lower weight and BMI (Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales Suárez-Varela, 2016). This could also explain why a little over half of the children were obese, since the majority continued to not be on a special diet. The weight of each child was not taken at the intermediate timeframe, nor follow-up, to be able to identify possible weight trends associated with the implementation of a special diet.

Medication/Supplement Use

The present study had a higher percentage of children on medications/supplements than special diets. There were also more children on vitamin/mineral supplements than special diets. In over half of these cases, a prescription by the doctor was provided. Similarly, Şenel (2010) found the category of "Vitamins and minerals" to be one of the most frequently used CAM treatments by parents, while other dietary supplements were the fourth most commonly used CAM treatment after sensory integration. "Vitamins and minerals" was perceived as being a highly beneficial CAM treatment by parents of children with ASD (Şenel, 2010). "Sleeping" – and- "eating" – improvements were reported for vitamin and mineral usage (Şenel, 2010). Children who reported psychotropic medication use had significantly lower current use of special diets (Perrin et al., 2012). This was similar to the findings in this study since more children were on medications, rather than special diets.

RQ#1: Changes in Food Group Consumption

Post-nutrition education (week 5) provided by RDs, parents reported statistically significant decreases in both sweet and snack consumption via the FFQ from baseline to follow-up. These differences may have been observed since snacks and sweets were decreased, rather than eliminated. Therefore, the change was subtler since children still received some snacks and sweets versus adding an unfamiliar food to a child's diet. Changes that were not statistically significant when comparing baseline to follow-up included changes in consumption for vegetables, dairy products, other protein foods, and fast food. Aversions to the texture, smell, color, and taste of vegetables, dairy products, and other protein foods could have contributed to the lack of statistically significant changes seen in their consumption. Additionally, inadequate exposure to these foods could've also played a role since some children with ASD tend to be more aversive to change. The lack of change seen in fast food consumption was likely attributed to parents having busy schedules, minimizing their cooking time at home. Increases in dairy products may be especially beneficial for these children since dairy has been mentioned as a nutrient of concern in children with ASD (Graf-Myles, 2013). Vegetable consumption by children with ASD, alongside TYP and DD children (Graf-Myles, 2013) has also been reported as inadequate. Nonsignificant changes in milk alternatives, grains, and soda or sweetened beverages were also observed. The lack of change in fast food and soda or sweetened beverages consumption could have been related to each other. Fruit, meat, and fat consumption essentially remained unchanged as well. Nonsignificant changes seen in the remaining food groups were also likely due to aversions to change, food preferences specific to each child, and resources available to parents. Thus, the nutrition education intervention had a positive effect on the consumption of some food groups in these children, but were unchanged for most. However,

although not statistically significant, there was a general trend for vegetables, dairy products, other protein foods, and fast food to be increasing while milk alternatives, grains, and soda or sweetened beverages were declining. The potential decrease in grain consumption is in line with the findings of Graf-Myles et al. (2013) that children with ASD, TD children, and developmentally delayed children without ASD consume inadequate fiber. This also would suggest that grains and folate may be special nutrient considerations for children with ASD (Graf-Myles, 2013). Overall, there was a greater trend toward a healthier mix of food consumption, except for in the areas of fast food and grains.

RQ#2: Changes in Food Consumption

Statistically significant differences were not found amongst the percent of food consumed and quantity of food items consumed post-intervention. Although nonsignificant, a declining trend was observed in the mean percentage of food consumed after the intervention. Likewise, there was a nonsignificant trend that suggested an increase in the number of food items consumed after the intervention. These trends suggest that parents placed a greater variety of foods in home-packed lunches that they provided to their children, and that their children tried more food items as a result. However, children most likely did not eat as much of their lunches because of the unfamiliar foods that were packed. The increased trend in the number of food items consumed after the intervention suggests that the nutrition education intervention promoted an increase in the variety of foods consumed by children with ASD. This supports the suggestion by Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela (2015) that children with a limited range of accepted foods may warrant interventions that involve dietitians or other specialists to encourage a variety in food consumption. Some of these

children already have several factors working against them related to optimal intake, such as atypical oral sensitivity which places them at an increased risk for potential nutrient deficiencies (Kral et al., 2015). The results from the present study are notable because they demonstrate the importance of a dietitian's role in improving the nutritional intake of this specific population of growing children. Over time, nutrition interventions that involve RD-parent interaction, RD-child interaction, or a combination of both can further assist in the optimization of critical growth and development phases encountered throughout childhood for this special population.

RQ#3: Changes in Nutrient Composition of Lunches

Statistically significant differences in the nutrients brought and consumed by children with ASD indicated that the children did not consume all of the food provided by parents in their home-packed lunches, with the exception of vitamin D. However, a variety of nonsignificant changes were still observed among these children. These nonsignificant changes will be the focus of the remainder of this discussion. Beneficial to children classified as overweight/obese, a declining trend in calories provided and consumed after the intervention was observed. Hyman et al. (2012) found similar results when comparing children with ASD to an NHANES matched sample. This can be an indication of portion size reductions, more nutrient-dense foods versus energy-dense foods, or a combination of both. There was essentially no change in the amount of fat provided, but less fat was consumed. Fat is the most calorically dense macronutrient at nine calories per gram, which likely contributed to the reduced caloric intake post-intervention. It is suboptimal that less protein was provided by parents and thus consumed by children. Hyman et al. (2012) and Zimmer et al. (2012) found similar results in that a lower quantity of protein was consumed by children with ASD, including selective eaters, in comparison to TD children. This

also supports the findings of Hyman et al. (2012) that selective eaters with autism are more likely to be at risk of inadequate vitamin B12 and zinc, which are nutrients predominately associated with meat consumption.

Although more calcium was provided by parents via home-packed lunches, less calcium was consumed after the intervention. Minimal exposure to the calcium sources prior to camp likely contributed to this, along with the possibility of a child having lactose intolerance depending on the calcium source provided. Various studies have supported the findings of suboptimal intakes of calcium amongst children with ASD (Hyman et al., 2012; Zimmer et al., 2012; Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela, 2015; Graf-Myles et al., 2013). Calcium is a special nutrient consideration within this specific population of children. This is especially true for children that may be on an elimination diet such as a GFCF diet. This study rose the quantity of vitamin D provided and consumed, which is extremely beneficial to these children, as previously mentioned studies have found children with ASD to consume inadequate amounts of vitamin D (Zimmer et al., 2012; Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela, 2015; Zimmer et al., 2012). Both calcium and vitamin D play important roles in bone growth and development. Additionally, sufficient vitamin D assists with calcium uptake.

The lower consumption of iron post-intervention correlated with the results from Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales-Suárez-Varela (2015) of inadequate iron consumption more frequently consumed by children with ASD. This could be related to the trends of protein provided and consumed, as the texture of proteins such as red meats, may not be well-accepted by children with ASD. Decreased sodium observed in this study contrasts with the elevated sodium seen in all age groups of children with ASD (Hyman et al.,

2012). Hyman et al. reported that 70.6% of children with ASD aged 4-8 years consumed sodium above the tolerable upper limit (UL). Although the present study did not observe correlations with sodium intake and the GFCF diet, a lower sodium consumption has been observed among children on this diet (Marí-Bauset, Llopis-González, Zazpe-García, Marí-Sanchis, & Morales Suárez-Varela, 2016).

RQ#4: Changes in Nutrient Composition of Lunches by Child BMI

Although the macro- and micronutrient composition of the lunches did not significantly differ by BMI category, there were some potential differences that may emerge with a larger sample size. The home-packed lunches provided by parents of children with ASD classified as underweight or normal weight appeared to be more nutrient-dense. This is especially true in regards to the micronutrient composition of the lunches. The sodium content was lower, while calcium, vitamin D and iron were higher in the lunches of underweight or normal weight children. The overall calories packed in the lunches of underweight or normal weight children increased after the intervention. However, fat content was also higher among these children, which likely explains the higher caloric intake. Protein consumption was higher among these children, which is an important nutrient in the development of muscles and a strong immune system. The underweight or normal weight children with ASD had more nutrient-dense meals, as their meals contained more total calories, fat, protein, vitamin D, calcium, iron and less sodium post-intervention. Most likely as a result of the nutrition intervention administered to parents, these positive dietary changes were observed. Positive changes seen in the lunches of overweight or obese children after the intervention included a lower content of total calories and fat, which likely intertwined with one another. The intervention may have motivated parents to apply newly

gained nutrition knowledge to further improve their child's quality of life using nutrition. Parents may have also previously felt the need and desire for dietary guidance, but lacked the tools and knowledge to initiate dietary changes. Previously mentioned literature has not examined the differences in meal compositions of children with ASD by BMI.

Summary

Mealtime behavioral issues more commonly observed in children with ASD can correlate with a decrease in nutrient-dense foods, resulting in a higher intake of energy-dense foods. The GFCF diet has been associated with a lower weight and BMI, but the majority of the subjects in this study were not on a special diet from baseline to follow-up. This could be because CAM usage in children is more common if their parents used CAM. More children were on medications/supplements and vitamin/mineral supplements rather than a special diet. The nutrition education intervention significantly improved the consumption of sweets and snacks, while displaying nonsignificant increases for vegetables, dairy products, other protein foods, and soda or sweetened beverages. After the intervention, parents of overweight or obese children packed lunches with lower total caloric and fat content. On the other hand, parents of underweight or normal weight children packed lunches with lower sodium, and higher vitamin D, calcium and iron content. The results of this study are promising despite the lack of statistical significance observed, as healthier dietary improvements were displayed due to involvement of the registered dietitians.

CHAPTER 6

CONCLUSION

The purposes of this study were to assess the types of foods provided by parents for lunch to children with Autism Spectrum Disorder attending a summer camp and to determine if a parental nutrition education intervention was effective in improving the dietary intake of children with ASD. This study was conducted using previously collected data. This chapter will discuss the conclusion, limitations, and future recommendations of the study.

Conclusion

In conclusion, the nutrition education intervention administered by two registered dietitians to parents of children with ASD attending a summer camp, was effective in improving the dietary intake of children with ASD in regards to the consumption of sweets and snacks. Although not statistically significant, there appeared to be a trend toward the consumption of a greater variety of foods, with more nutrient-dense foods and fewer energy-dense foods being observed from baseline to follow-up. This study indicates the importance of a registered dietitian as part of the multidisciplinary team of children with ASD to maximize and optimize nutrient consumption. Some children with ASD tend to be at a higher risk of nutrient deficiencies, especially when elimination diets are utilized as part of CAM treatment. Prevention of nutrient

deficiencies by registered dietitians can tremendously improve the quality of life for these children and their parents or caregivers.

Strengths and Limitations

The primary strength of this study is that it was the first study to assess the efficacy of an RD-led parental nutrition education intervention designed for children with ASD attending a summer camp. The study evaluated the diet quality of children with ASD by using both a FFQ and analyzation of home-packed lunches at the summer camp, rather than using the FFQ alone. This assisted with strengthening the results by allowing further interpretation of the impact of the intervention on what parents packed their children for lunch at camp. The main weaknesses of this study were the small sample size and the short duration period of the study, which made it difficult to have statistically significant results. However, the sample size was based on the number of students enrolled in this particular summer camp. Reliability was not conducted on the FFQ that was created by the registered dietitians. Other factors surrounding the diet of these children were not assessed, such as, food allergies, sensitivities or intolerances. This would have expanded the interpretation of the results.

Future Recommendations

Additional research is needed to strengthen the results of this study, with the use of a larger, more heterogeneous sample size that consists of diverse ethnicities, a variety of age groups, and more participants in each group. This study would have also benefitted by having a longer duration and assessing more objective variables to determine efficacy of the parental intervention. More involvement with parents, including multiple nutrition education sessions

would provide a much greater insight to the study and the FFQ should be validated and reliable. To impart behavior change, a substantial amount of time is required, and the intervention was RD-parent focused, rather than RD-child focused. Thus, changing the eating patterns of the children would require more interactions between the RDs and children. Direct observation of the children should occur at real time. More importantly, this study supported the inclusion of registered dietitians on the multidisciplinary team for children with ASD. Important considerations include close monitoring, as there are various factors such as medications, mealtime behaviors, severity of ASD, and CAM usage, that can influence the nutritional status of children with ASD. These are some factors that should be accounted for by registered dietitians that work with these children in order to prevent hindrance of growth and development. Nutritional deficiencies should also be prevented, as these would interfere with the child's quality of life.

Summary

Nutrition education interventions administered by registered dietitians can improve the dietary intake of children with ASD. By reducing the number of sweets and snacks consumed as a result of the nutrition intervention, potentially a greater variety of foods may be consumed that are more nutrient-dense foods critical for growth and development. In childhood, growth and development is a very rapid process that requires adequate amounts of macro- and micronutrients to successfully occur. Having a registered dietitian as part of the multidisciplinary team of children with ASD is extremely important to improve the nutritional intake of these children, especially since they don't consume all of their meals. This makes optimization of nutrition even more critical.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD MATERIALS

Appendix A-1 IRB Approval Letter
Appendix A-2 IRB Approval Letter of Modification
Appendix A-3 CITI Certificate of Completion

Appendix A-1 – IRB Approval Letter

Office of Research Integrity
Institutional Review Board (IRB)
2000 University Avenue
Muncie, IN 47306-0155
Phone: 765-285-5070

DATE:	May 27, 2015
TO:	Amber Haroldson, PhD
FROM:	Ball State University IRB
RE:	IRB protocol # 753403-2
TITLE:	Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp
SUBMISSION TYPE:	Revision
ACTION:	APPROVED
DECISION DATE:	May 27, 2015
EXPIRATION DATE:	May 26, 2017
REVIEW TYPE:	**Expedited:** This protocol had been determined by the board to meet the definition of minimal risk.

The Institutional Review Board has approved your Revision for the above protocol, effective May 27, 2015 through May 26, 2017. All research under this protocol must be conducted in accordance with the approved submission and in accordance with the principles of the Belmont Report.

Review Type:

	Category 1: Clinical studies of drugs and medical devices
	Category 2: Collection of blood samples by Finger stick, Heel stick, Ear stick, or Venipuncture
	Category 3: Prospective collection of biological specimens for research purposes by noninvasive means
	Category 4: Collection of data through Non-Invasive Procedures Routinely Employed in Clinical Practice, excluding procedures involving Material (Data, Documents, Records, or Specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis)
	Category 5: Research involving materials that have been collected or will be collected solely for non-research purposes.
	Category 6: Collection of Data from Voice, Video, Digital, or Image Recordings Made for Research Purposes

X	**Category 7:** Research on Individual or Group Characteristics or Behavior or Research Employing Survey, Interview Oral History, Focus Group, Program Evaluation, Human Factors, Evaluation, or Quality Assurance Methodologies
	Category 8: Continuing review of research previously approved by the convened IRB
	Category 9: Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories 2-8 do not apply but the IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk and not additional risks have been identified.

Editorial Notes:

1. APPROVE

As a reminder, it is the responsibility of the P.I. and/or faculty sponsor to inform the IRB in a timely manner:

- when the project is completed,
- if the project is to be continued beyond the approved end date,
- if the project is to be modified,
- if the project encounters problems, or
- if the project is discontinued.

Any of the above notifications must be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb). Please reference the IRB protocol number given above in any communication to the IRB regarding this project. Be sure to allow sufficient time for review and approval of requests for modification or continuation. If you have questions, please contact Jennifer Weaver at 765-285-5034 or jmweaver@bsu.edu.

In the case of an adverse event and/or unanticipated problem, you will need to submit written documentation of the event to IRBNet under this protocol number and you will need to directly notify the Office of Research Integrity (http://www.bsu.edu/irb) **within 5 business days**. If you have questions, please contact (ORI Staff).

Please note that all research records must be retained for a minimum of three years after the completion of the project or as required under Federal and/or State regulations (ex. HIPAA, FERPA, etc.). Additional requirements may apply.

Bryan Byers, PhD/Chair
Institutional Review Board

Christopher Mangelli, JD, MS, MEd, CIP/Director
Office of Research Integrity

Appendix A-2 – IRB Approval Letter of Modification

Office of Research Integrity
Institutional Review Board (IRB)
2000 University Avenue
Muncie, IN 47306-0155
Phone: 765-285-5070

DATE:	August 18, 2016
TO:	Amber Haroldson, PhD
FROM:	Ball State University IRB
RE:	IRB protocol # 753403-5
TITLE:	Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp
SUBMISSION TYPE:	Amendment/Modification
ACTION:	APPROVED
DECISION DATE:	August 18, 2016
EXPIRATION DATE:	May 26, 2017
REVIEW TYPE:	**Expedited:** This protocol had been determined by the board to meet the definition of minimal risk.

The Institutional Review Board has approved your Amendment/Modification for the above protocol, effective August 18, 2016 through May 26, 2017. All research under this protocol must be conducted in accordance with the approved submission and in accordance with the principles of the Belmont Report.

Review Type:

	Category 1: Clinical studies of drugs and medical devices
	Category 2: Collection of blood samples by Finger stick, Heel stick, Ear stick, or Venipuncture
	Category 3: Prospective collection of biological specimens for research purposes by noninvasive means
	Category 4: Collection of data through Non-Invasive Procedures Routinely Employed in Clinical Practice, excluding procedures involving Material (Data, Documents, Records, or Specimens) that have been collected, or will be collected solely for non-research purposes (such as medical treatment or diagnosis)
	Category 5: Research involving materials that have been collected or will be collected solely for non-research purposes.
	Category 6: Collection of Data from Voice, Video, Digital, or Image Recordings Made for Research Purposes

	Category 7: Research on Individual or Group Characteristics or Behavior or Research Employing Survey, Interview Oral History, Focus Group, Program Evaluation, Human Factors, Evaluation, or Quality Assurance Methodologies
	Category 8: Continuing review of research previously approved by the convened IRB
	Category 9: Continuing review of research, not conducted under an investigational new drug application or investigational device exemption where categories 2-8 do not apply but the IRB has determined and documented at a convened meeting that the research involves no greater than minimal risk and not additional risks have been identified.

Editorial Notes:

1. Modification Approved

As a reminder, it is the responsibility of the P.I. and/or faculty sponsor to inform the IRB in a timely manner:

- when the project is completed,
- if the project is to be continued beyond the approved end date,
- if the project is to be modified,
- if the project encounters problems, or
- if the project is discontinued.

Any of the above notifications must be addressed in writing and submitted electronically to the IRB (http://www.bsu.edu/irb). Please reference the IRB protocol number given above in any communication to the IRB regarding this project. Be sure to allow sufficient time for review and approval of requests for modification or continuation. If you have questions, please contact John Mulcahy at (765) 285-5106 or jmulcahy@bsu.edu.

In the case of an adverse event and/or unanticipated problem, you will need to submit written documentation of the event to IRBNet under this protocol number and you will need to directly notify the Office of Research Integrity (http://www.bsu.edu/irb) **within 5 business days**. If you have questions, please contact (ORI Staff).

Please note that all research records must be retained for a minimum of three years after the completion of the project or as required under Federal and/or State regulations (ex. HIPAA, FERPA, etc.). Additional requirements may apply.

Bryan Byers, PhD/Chair
Institutional Review Board

Christopher Mangelli, JD, MS, MEd, CIP/Director
Office of Research Integrity

Appendix A-3 – CITI Certificate of Completion

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** Katelynn Maclin (ID: 5564679)
- **Email:** khmaclin@bsu.edu
- **Institution Affiliation:** Ball State University (ID: 1568)
- **Institution Unit:** Nutrition & Dietetics

- **Curriculum Group:** Social & Behavioral Research - Basic/Refresher
- **Course Learner Group:** Same as Curriculum Group
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 19587685
- **Completion Date:** 20-May-2016
- **Expiration Date:** 20-May-2019
- **Minimum Passing:** 80
- **Reported Score*:** 94

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction (ID: 1127)	19-May-2016	3/3 (100%)
Students in Research (ID: 1321)	19-May-2016	4/5 (80%)
History and Ethical Principles - SBE (ID: 490)	19-May-2016	4/5 (80%)
Defining Research with Human Subjects - SBE (ID: 491)	19-May-2016	4/5 (80%)
The Federal Regulations - SBE (ID: 502)	19-May-2016	5/5 (100%)
Assessing Risk - SBE (ID: 503)	19-May-2016	5/5 (100%)
Informed Consent - SBE (ID: 504)	20-May-2016	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	20-May-2016	5/5 (100%)
Research with Prisoners - SBE (ID: 506)	20-May-2016	4/5 (80%)
Research with Children - SBE (ID: 507)	20-May-2016	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	20-May-2016	5/5 (100%)
International Research - SBE (ID: 509)	20-May-2016	5/5 (100%)
Internet-Based Research - SBE (ID: 510)	20-May-2016	4/5 (80%)
Research and HIPAA Privacy Protections (ID: 14)	20-May-2016	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	20-May-2016	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	20-May-2016	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	20-May-2016	5/5 (100%)
Ball State University (ID: 13475)	20-May-2016	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: https://www.citiprogram.org/verify/?08fadd25-e7b2-4e21-bbe3-d5d36f1b88b0

CITI Program
Email: support@citiprogram.org
Phone: 888-529-5929
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COMPLETION REPORT - PART 2 OF 2
COURSEWORK TRANSCRIPT**

** NOTE: Scores on this Transcript Report reflect the most current quiz completions, including quizzes on optional (supplemental) elements of the course. See list below for details. See separate Requirements Report for the reported scores at the time all requirements for the course were met.

- **Name:** Katelynn Maclin (ID: 5564679)
- **Email:** khmaclin@bsu.edu
- **Institution Affiliation:** Ball State University (ID: 1568)
- **Institution Unit:** Nutrition & Dietetics

- **Curriculum Group:** Social & Behavioral Research - Basic/Refresher
- **Course Learner Group:** Same as Curriculum Group
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for Investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 19587685
- **Report Date:** 07-Dec-2016
- **Current Score**:** 94

REQUIRED, ELECTIVE, AND SUPPLEMENTAL MODULES	MOST RECENT	SCORE
Students in Research (ID: 1321)	19-May-2016	4/5 (80%)
Ball State University (ID: 13475)	20-May-2016	No Quiz
History and Ethical Principles - SBE (ID: 490)	19-May-2016	4/5 (80%)
Defining Research with Human Subjects - SBE (ID: 491)	19-May-2016	4/5 (80%)
Belmont Report and CITI Course Introduction (ID: 1127)	19-May-2016	3/3 (100%)
The Federal Regulations - SBE (ID: 502)	19-May-2016	5/5 (100%)
Assessing Risk - SBE (ID: 503)	19-May-2016	5/5 (100%)
Informed Consent - SBE (ID: 504)	20-May-2016	5/5 (100%)
Privacy and Confidentiality - SBE (ID: 505)	20-May-2016	5/5 (100%)
Research with Prisoners - SBE (ID: 506)	20-May-2016	4/5 (80%)
Research with Children - SBE (ID: 507)	20-May-2016	5/5 (100%)
Research in Public Elementary and Secondary Schools - SBE (ID: 508)	20-May-2016	5/5 (100%)
International Research - SBE (ID: 509)	20-May-2016	5/5 (100%)
Internet-Based Research - SBE (ID: 510)	20-May-2016	4/5 (80%)
Research and HIPAA Privacy Protections (ID: 14)	20-May-2016	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees (ID: 483)	20-May-2016	4/4 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID: 14928)	20-May-2016	5/5 (100%)
Conflicts of Interest in Research Involving Human Subjects (ID: 488)	20-May-2016	5/5 (100%)

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

Verify at: https://www.citiprogram.org/verify/?08fadd25-e7b2-4e21-bbe3-d5d36f1b88b0

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Phone: 888-529-5929
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APPENDIX B

SURVEY INSTRUMENT

Appendix B – Food Frequency Questionnaire

Child Food Frequency Questionnaire

Please answer the following questions about your child's food intake to the best of your ability. Some examples of foods that would fit in each group are included in parentheses.

Parent's E-mail Address: _____

Child's Name: _____

Child's Age: _____ years old Child's Gender: ◯ Male ◯ Female

1. On average, how many times a day does your child eat **Fruits** (fresh or frozen, but not juice)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

2. On average, how many times a day does your child eat **Vegetables** (fresh, canned or frozen)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

3. On average, how many times a day does your child eat or drink **Dairy Products** (cow's milk, yogurt, or cheese)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

4. On average, how many times a day does your child eat or drink **Milk Alternatives** (soy milk, almond milk, rice milk)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

5. On average, how many times a day does your child eat **Meat** (beef, chicken, turkey, fish, seafood, pork)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

6. On average, how many times a day does your child eat **Other Protein Foods** (nuts, nut butters, eggs, beans, veggie burgers)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

7. On average, how many times a day does your child eat **Grains** (bread, pasta, rice, noodles, macaroni, lasagna, crackers, pancakes, muffins)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

8. On average, how many times a day does your child eat **Sweets** (chocolates, candies, fruit snacks/gummies, cookies)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

9. On average, how many times a day does your child eat **Fats** (butter, margarine, vegetable oil, olive oil)?
   - ◯ 0
   - ◯ 1-2
   - ◯ 3-4
   - ◯ 5-6
   - ◯ >6

10. On average, how many times a day does your child eat **Fast Food** (cheeseburger, chicken strips, French fries, pizza, tacos)?
    - ◯ 0
    - ◯ 1-2
    - ◯ 3-4
    - ◯ 5-6
    - ◯ >6

11. On average, how many times a day does your child eat **Sodas or Sweet Beverages** (regular soda, diet soda, Kool-aid®, fruit drink)?
    - ◯ 0
    - ◯ 1-2
    - ◯ 3-4
    - ◯ 5-6
    - ◯ >6

12. On average, how many times a day does your child eat **Snacks** (potato chips, pretzels, cheese puffs)?
    - ◯ 0
    - ◯ 1-2
    - ◯ 3-4
    - ◯ 5-6
    - ◯ >6

13. Are there any other foods your child usually eats that did not fit in one of these categories?
    - ☐ No
    - ☐ Yes
      - If yes, please list: _____
        _____
        _____

14. Please list your child's **most frequently** consumed food in each of the following groups (if the child does not eat foods in that food group please write "None").

Fruits: _____

Vegetables: _____

Dairy or Milk Alternatives: _____

Meat or Other Protein Foods: _____

Grains: _____

Sweets: _____

Fats: _____

Fast Foods: _____

Soda/Sweet Beverages: _____

Snacks: _____

15. Please list any **food allergies** you child has: _____

_____

16. Please check the box next to any **special diets** your child is on.

- ☐ Casein-free diet
- ☐ Gluten-free diet
- ☐ Other: _____

17. Please list any other foods or ingredients that try to have your child **avoid** eating.

_____

18. Does your child take any **medications or supplements** (check all that apply)?

- ☐ No medications or supplements
- ☐ Yes, vitamin/mineral supplements
- ☐ Yes, prescribed by the doctor
- ☐ Yes, over the counter

Thank you for your time.

APPENDIX C

LETTERS OF CONSENT

Appendix C-1 Informed Consent Form

Appendix C-2 Parental Consent Form

Appendix C-3 Child Assent Form

Appendix C-1 – Informed Consent Form

PARENTAL/LEGAL GUARDIAN INFORMED CONSENT FORM

TITLE OF RESEARCH STUDY
Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp

INVITATION
You are invited to participate in this research study. Your participation is voluntary. The information in this consent form is provided to help you decide whether or not to participate. If you have any questions, please do not hesitate to ask. You can find our contact information at the bottom of this consent form.

WHY ARE MY CHILD AND I ELIGIBLE?
Since you are the parent/legal guardian of a child between the ages of 6 and 12 with a diagnosis of an autism spectrum disorder (ASD), your child may be eligible to participate. We seek children with ASD who are participating in the 2015 Autism Day Camp.

WHAT IS THE PURPOSE OF THIS STUDY?
The purpose of this study is to 1) assess the types of foods commonly consumed by children with ASD and provided by parents for lunch at summer camp, and 2) determine the effectiveness of a nutrition education intervention for the parents of children with ASD on improving child dietary intake.

WHAT DOES THIS STUDY INVOLVE?
We will ask you to fill out a brief questionnaire about your child's food intake three separate times (before the camp, during the camp, and after the camp). The first two questionnaires will be taken in-person and the last one will be sent to you by e-mail. We also ask that you participate in a nutrition education session during the third week of summer camp.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS I COULD EXPERIENCE?
Researchers must always consider if there are any possible risks or discomforts to children participating in research. You could experience the following risk or discomfort during this study:
There is minimal to no risk for participation in the present study. Parents may become mildly uncomfortable in having their child observed. However, no one will see the data except for the research staff. The data will be kept in a locked filing cabinet in a locked office on campus.

WHAT ARE THE POSSIBLE BENEFITS TO ME?
It is expected that you could benefit from participation in the research project by gaining nutrition knowledge and information you can use to try to provide healthier food options for your child.

MANDATORY REPORTING
If researchers are given reason to believe a child has been abused (physically, sexually, or psychologically) or neglected by individuals outside of camp or camp staff, they are mandated to report their concerns to Child Protective Services. Children with disabilities are at higher risk for abuse than other individuals so researcher must be prepared to act in the best interest of the child.

WHAT ARE THE POSSIBLE BENEFITS TO SOCIETY?
We expect to share the results of this study with other professionals at national conferences and through professional journals. The information we get from this study may be used to help other children with ASD who attend remedial summer camps.

WHAT ARE YOUR FINANCIAL OBLIGATIONS?
You are not responsible for any activities related to this research. It will occur in the context of 2015 Autism Day Camp, which you already plan for your child to attend.

Initials_____ Witness_____

WILL YOU BE PAID FOR YOUR CHILDREN'S PARTICIPATION IN THIS STUDY?
You will not be paid to be in this study.

WHAT SHOULD YOU DO IN CASE OF AN EMERGENCY?
Emergency medical treatment is available through the camp if your child becomes injured or ill during his activities at the 2015 Autism Day Camp. You will be responsible for the costs of any medical care that is provided. It is understood that in the unlikely event of an injury or illness of any kind as a result of your participation in this research project that Ball State University, its agents, and employees will assume whatever responsibility is required by law. If any injury or illness occurs in the course of your child's participation in this research project, please seek treatment as appropriate and notify the Principal Investigator as soon as possible.

Counseling services can be obtained from Ball State University Counseling Practicum Clinic at (765) 285-8047 if your child develops uncomfortable feelings during your participation in this research project. You will be responsible for the costs of any care that is provided. It is understood that in the unlikely event that treatment is necessary as a result of your child's participation in this research project that Ball State University, its agents and employees will assume whatever responsibility is required by law.

HOW WILL YOUR CONFIDENTIALITY BE PROTECTED?
Reasonable steps will be taken to protect your privacy and the confidentiality of study data, which includes observational data and questionnaire data, will only be reviewed by research staff. Copies of the data will be kept in a secure location (One of the primary investigator's offices in a locked cabinet) indefinitely. A copy of the consent form will be in a locked file cabinet of one of the primary investigators.

The only persons who will have access to your research records are the study personnel and the Institutional Review Board (IRB). The information from this study may be published in scientific journals or presented at scientific meetings, but your child's identity will be kept strictly confidential.

WHAT WILL HAPPEN IF YOU DECIDE NOT TO PARTICIPATE?
You can decide not to participate in this study, or you can withdraw from this study at any time. Your decision will not affect your child's care, or your relationship with the investigator, or Ball State University. Your decision will not result in any loss of benefits to which your child is entitled. If any new information develops during the course of this study that may affect your willingness to allow your child to continue participating, you will be informed immediately.

IRB CONTACT INFORMATION
For questions about your rights as a research subject, please contact the Director, Office of Research Integrity, Ball State University, Muncie, IN 47306, (765) 285-5070 or at irb@bsu.edu

DOCUMENTATION OF INFORMED CONSENT
YOU ARE VOLUNTARILY MAKING A DECISION TO ALLOW YOURSELF TO PARTICIPATE IN THIS

Study title: Dietary Intake of Children with Autism Spectrum Disorder Enrolled in a Summer Camp

Initials_____ Witness_____

RESEARCH. YOUR SIGNATURE MEANS THAT YOU HAVE READ AND UNDERSTOOD THE INFORMATION PRESENTED AND DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE. YOUR SIGNATURE ALSO MEANS THAT THE INFORMATION ON THIS CONSENT FORM HAS BEEN FULLY EXPLAINED TO YOU AND ALL YOUR QUESTIONS HAVE BEEN ANSWERED TO YOUR SATISFACTION. IF YOU THINK OF ANY ADDITIONAL QUESTIONS DURING THIS STUDY, YOU SHOULD CONTACT THE INVESTIGATOR(S). YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM.

_____ _____
SIGNATURE OF PARENT **DATE**

_____ _____
SIGNATURE OF PARENT **DATE**

_____ _____
SIGNATURE OF WITNESS **DATE**

I CERTIFY THAT ALL THE ELEMENTS OF INFORMED CONSENT DESCRIBED ON THIS CONSENT FORM HAVE BEEN EXPLAINED FULLY TO THE PARENT(S)/LEGALLY AUTHORIZED REPRESENTATIVE. IN MY JUDGEMENT, THE PARENT(S)/LEGALLY AUTHORIZED REPRESENTATIVE IS/ARE VOLUNTARILY AND KNOWINGLY GIVING INFORMED CONSENT AND POSSESS(ES) THE LEGAL CAPACITY TO GIVE INFORMED CONSENT TO PARTICIPATE IN THIS RESEARCH.

_____ _____
SIGNATURE OF INVESTIGATOR **DATE**

AUTHORIZED STUDY PERSONNEL

Principal Investigators:

Amber Haroldson, PhD, RD
Department of Family and Consumer Sciences
AT 150
Ball State University
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Appendix C-2 – Parental Consent Form

PARENTAL/LEGAL GUARDIAN PARENTAL CONSENT FORM

TITLE OF RESEARCH STUDY
Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp

INVITATION
Your child is invited to participate in this research study. The information in this consent form is provided to help you decide whether or not to participate. Participation is voluntary. If you have any questions, please do not hesitate to ask. You can find our contact information at the bottom of this consent form.

WHY IS MY CHILD ELIGIBLE?
Since you are the parent/legal guardian of a child between the ages of 6 and 12 with a diagnosis of an autism spectrum disorder (ASD), your child may be eligible to participate. We seek children with ASD who are participating in the 2015 Autism Day Camp.

WHAT IS THE PURPOSE OF THIS STUDY?
The purpose of this study is to 1) assess the types of foods commonly consumed by children with ASD and provided by parents for lunch at a summer camp, and 2) determine the effectiveness of a nutrition education intervention for the parents of children with ASD on improving ' dietary intake of children.

WHAT DOES THIS STUDY INVOLVE?
We will ask you to fill out a brief questionnaire about your child's food intake three separate times (before the camp, during the camp, and after the camp). The first two questionnaires will be taken in-person and the last one will be sent to you by e-mail. Also, we will record what food your child brings for lunch on two separate weeks during the camps.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS MY CHILD COULD EXPERIENCE?
Researchers must always consider if there are any possible risks or discomforts to children participating in research. Your child could experience the following risk or discomfort during this study:
There is minimal to no risk for participation in the present study. Parents may become mildly uncomfortable in having their child observed. However, no one will see the data except for the research staff. The data will be kept in a locked filing cabinet in a locked office on campus.

WHAT ARE THE POSSIBLE BENEFITS TO MY CHILD?
It is expected that your child could benefit from participation in the research project by their parent's gaining nutrition knowledge and information can be used to provide healthier food options to the child.

MANDATORY REPORTING
If researchers are given reason to believe a child has been abused (physically, sexually, or psychologically) or neglected by individuals outside of camp or camp staff, they are mandated to report their concerns to Child Protective Services. Children with disabilities are at higher risk for abuse than other individuals so researchers must be prepared to act in the best interest of the child.

WHAT ARE THE POSSIBLE BENEFITS TO SOCIETY?
We expect to share the results of this study with other professionals at national conferences and through professional journals. The information we get from this study may be used to help other children with ASD who attend remedial summer camps.

WHAT ARE YOUR FINANCIAL OBLIGATIONS?
You are not responsible for any activities related to this research. It will occur in the context of 2015 Autism Day Camp, which you already plan for your child to attend.

Initials_____ Witness_____

WILL YOU BE PAID FOR YOUR CHILDREN'S PARTICIPATION IN THIS STUDY?
Your children will not be paid to be in this study.

WHAT SHOULD YOU DO IN CASE OF AN EMERGENCY?
Emergency medical treatment is available through the camp if your child becomes injured or ill during his activities at the 2015 Autism Day Camp. You will be responsible for the costs of any medical care that is provided. It is understood that in the unlikely event of an injury or illness of any kind as a result of your participation in this research project that Ball State University, its agents, and employees will assume whatever responsibility is required by law. If any injury or illness occurs in the course of your child's participation in this research project, please seek treatment as appropriate and notify the Principal Investigator as soon as possible.

Counseling services can be obtained from Ball State University Counseling Practicum Clinic at (765) 285-8047 if your child develops uncomfortable feelings during your participation in this research project. You will be responsible for the costs of any care that is provided. It is understood that in the unlikely event that treatment is necessary as a result of your child's participation in this research project that Ball State University, its agents and employees will assume whatever responsibility is required by law.

HOW WILL YOUR CHILD'S CONFIDENTIALITY BE PROTECTED?
Reasonable steps will be taken to protect your family's privacy and the confidentiality of your child's study data, which includes observational data and questionnaire data, will only be reviewed by research staff. Copies of the data will be kept in a secure location (One of the primary investigator's offices in a locked cabinet) indefinitely. A copy of the consent form will be in a locked file cabinet of one of the primary investigators.

The only persons who will have access to your child's research records are the study personnel and the Institutional Review Board (IRB). The information from this study may be published in scientific journals or presented at scientific meetings, but your child's identity will be kept strictly confidential.

WHAT WILL HAPPEN IF YOU DECIDE NOT TO PARTICIPATE?
You can decide not to participate in this study, or you can withdraw from this study at any time. Your decision will not affect your child's care, or your relationship with the investigator, or Ball State University. Your decision will not result in any loss of benefits to which your child is entitled. If any new information develops during the course of this study that may affect your willingness to allow your child to continue participating, you will be informed immediately.

IRB CONTACT INFORMATION
For questions about your rights as a research subject, please contact the Director, Office of Research Integrity, Ball State University, Muncie, IN 47306, (765) 285-5070 or at irb@bsu.edu

DOCUMENTATION OF INFORMED CONSENT

YOU ARE VOLUNTARILY MAKING A DECISION TO ALLOW YOUR CHILD TO PARTICIPATE IN THIS RESEARCH. YOUR SIGNATURE MEANS THAT YOU HAVE READ AND UNDERSTOOD THE INFORMATION PRESENTED AND DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE. YOUR SIGNATURE ALSO MEANS THAT THE INFORMATION ON THIS CONSENT FORM HAS BEEN FULLY EXPLAINED TO YOU AND ALL YOUR QUESTIONS HAVE BEEN ANSWERED TO YOUR SATISFACTION. IF YOU THINK OF ANY ADDITIONAL QUESTIONS DURING THIS STUDY, YOU SHOULD CONTACT THE INVESTIGATOR(S). YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM.

_____ _____

SIGNATURE OF PARENT **DATE**

_____ _____

SIGNATURE OF PARENT **DATE**

_____ _____

SIGNATURE OF WITNESS **DATE**

I CERTIFY THAT ALL THE ELEMENTS OF INFORMED CONSENT DESCRIBED ON THIS CONSENT FORM HAVE BEEN EXPLAINED FULLY TO THE PARENT(S)/LEGALLY AUTHORIZED REPRESENTATIVE. IN MY JUDGEMENT, THE PARENT(S)/LEGALLY AUTHORIZED REPRESENTATIVE IS/ARE VOLUNTARILY AND KNOWINGLY GIVING INFORMED CONSENT AND POSSESS(ES) THE LEGAL CAPACITY TO GIVE INFORMED CONSENT TO PARTICIPATE IN THIS RESEARCH.

_____ _____

SIGNATURE OF INVESTIGATOR **DATE**

AUTHORIZED STUDY PERSONNEL

Principal Investigators:

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Appendix C-3 – Child Assent Form

CHILD ASSENT FORM

TITLE OF RESEARCH STUDY
Dietary Intake of Children with Autism Spectrum Disorder (ASD) Enrolled in a Summer Camp

INVITATION AND STUDY DESCRIPTION

1. We would like to ask you to be in this study that is focused on observing what you do in camp. We would like to observe you while you are eating lunch.

2. Sometimes while we are observing we also will be taking notes. These notes will be used to make sure we are observing the right things so we can go back later and develop some helpful strategies that will improve your dietary practices. The intent of doing this is to make sure we did not miss anything. After we are done with the notes, we will destroy them.

2. We would like you to talk to your parents about this before you decide whether or not to be in this study. We have already talked to them about you being in the study. But you get to decide if you want to be in this study.

3. If you have any questions at any time, please ask.

4. In this study, we want to see what kinds of foods you bring for lunch from home and how much you eat.

5. When we are observing your behavior, you most likely will not know we are observing you because all children in the camp will be observed everyday while they are in camp. However, you might become frustrated if you feel like we are observing you. It is OK to feel this way. We have tried to make this less frustrating by making sure that the children are unaware of when they are being observed.

Some other campers may notice that we are observing your group but they will not know whom we are observing.

6. If we can see what types of food you are bringing to camp, we can make suggests to help make your lunch healthier.

7. You do not have to be in this study. If you don't want to do it, you don't have to. If you decide to be in the study, you are free to stop at any time. Your decision will not have any affect on your chance to be at camp or to change the relationship that you or any of your family members have with professionals at Ball State University.

8. If you get very upset while you are involved in this study, you should let your parent or care-provider know right away. They will know how to help you or get you the help you need.

9. No one will be paid for participating in this study.

10. If we find out that a grownup has hurt you, we will make sure you are safe. This might mean calling your parents (or care-providers) or calling the police. If we did that, you would not be in any trouble. It only means that the police or your parents (or care-providers) will work to make sure you are safe.

Initials_____ Witness_____

11. Your name and participation in this study will be kept confidential. That means we will keep it secret. We will keep the notes or any information from the project in a file people other than the researchers will not be able to see. No one will know you participated in this study unless you or someone in your family tells someone. The notes made of you being at camp will be stored in a locked filing cabinet in a locked office so only researchers can see them.

YOU ARE MAKING A DECISION WHETHER OR NOT TO BE IN THIS STUDY. SIGNING THIS FORM MEANS THAT YOU HAVE DECIDED TO BE IN THIS STUDY. IF YOU DON'T KNOW HOW TO SIGN, WE CAN MARK THE BOX BELOW IF YOU TELL US YOU WANT TO BE IN THIS STUDY. YOU AND YOUR PARENTS WILL BE GIVEN A COPY OF THIS FORM.

_____ _____

SIGNATURE OF PARTICIPANT **DATE**

MARK BOX IF STUDENT AGREES BUT CANNOT SIGN ☐
(Please date on line above)

_____ _____

SIGNATURE OF INVESTIGATOR/WITNESS **DATE**

AUTHORIZED STUDY PERSONNEL

Principal Investigators:

Amber Haroldson, PhD, RD
Department of Family and Consumer Sciences
AT 150
Ball State University
Muncie, IN 47306
Telephone: (765) 285-7940
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Jay Kandiah, PhD, RD, CD
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Ball State University
Muncie, IN 47306
Telephone: (765) 285-5955
Email: jkandiah@bsu.edu

Initials_____ Witness_____

APPENDIX D

NUTRITION EDUCATION MATERIALS

Appendix D-1 Autism and Diet Handout
Appendix D-2 Food Groups Handout
Appendix D-3 Autism Special Diets Handout

Nutrition Information for Children with Autism

A brief guide to feeding a child with Autism

Background

Autism Spectrum Disorders (ASD) is a complex developmental condition that typically appears during the first 3 years of a child's life. It effects brain function, specifically in the areas of social interaction and communication.

Although there is no known "cure" for ASD, several changes in the diet have the potential to reduce the symptoms that your child may be experiencing. This handout provides some tips and tricks t… meals, working aroun… and sensitivities, and … unacceptable food tex…

As always, it is impor… your child's doctor or… making any dietary changes. This handout will provide a few tips to ensure that your child consumes a well-balanced diet and stays as healthy as possible.

For more information, please visit the following websites:

http://www.eatright.org/resource/health/diseases-and-conditions/autism/autism-spectrum-disorders-asd-and-diet

http://www.autism.com/treating_diets

https://www.autismspeaks.org/science/science-news/nutrition-and-autism

http://www.webmd.com/brain/autism/news/20110928/diet-autism-what-works

http://www.tacanow.org/family-resources/an-essential-handout-for-teachers-aides/

http://autism-help.org/behavior-fussy-eaters.htm

Creating Healthy Meals

In general, nutritional needs are the same for all children, with or without autism. It is important to make sure that your child is consuming a well-balanced diet for proper growth and development.

Tips:

Aim for one food from at least three different food groups at each meal.

Ex. 1 protein, 1 fruit, and 1 grain

Offer your child choices rather than forcing them to eat one food. Ex. Let your child choose between carrots, peas or broccoli.

Shoot for a colorful plate. If your child's meal is colorful rather than bland, it likely contains a variety of important nutrients.

Try offering "healthy" versions of your child's favorites.

Ex. Whole grain, low-fat, low-sugar

varieties

Be flexible.

Offering the right foods is not always a guarantee that your child will accept them. However, if you follow the tips on following panel, meal time can gradually become less

Food Aversions and Sensitivities

Most children go through stages of picky eating. In children with autism, this can be an even bigger issue. Your child may experience the following:

Sensitivity to the taste, smell, color, or texture of foods

Avoidance of foods or whole food groups

It is important to work around your child's food quirks, as they can quickly lead to nutritional deficiencies.

Tips:

DO:

Eliminate food allergies or other medical causes of food avoidance

Take baby steps (look, smell, touch, then taste)

Serve new foods with familiar favorites

Offer new foods persis

Experiment with textu

Make mealtime fun!

DON'T:

Force your child to eat

foods

Use rewards to

Dealing with Texture

It is common for children with autism to have an aversion to certain food textures. Often, your child may simply refuse to eat a food, without the ability to communicate what about the food they dislike. Each child is different, making experimentation important in finding a routine that works for your family.

Tips:

Keep a record of what

your child eats

or

doesn't eat, and

look

for patterns.

Ex. Write down what, when, where, and how your child eats (including texture, temperature, smell, and color).

Introduce foods with a similar texture to a favorite food.

Appendix D-2 – Food Groups Handout

Fun with Food Groups

Creating balanced meals does not have to be a difficult or boring task. Within each food group, there are many choices that can be mixed and matched to create fun and nutritious meals. Below you will find just some of the options that you can choose from when putting together meals for your child.

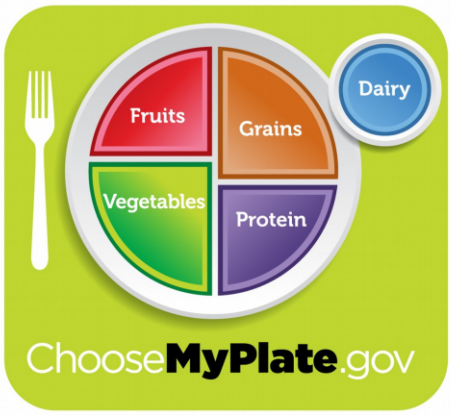
Fruits Apples, peaches, pears, bananas, pineapple, grapes, blueberries, strawberries, raspberries, kiwi, watermelon, cantaloupe, cherries, oranges

Vegetables Carrots, broccoli, cucumbers, peppers, zucchini, potatoes, tomatoes, lettuce, spinach, celery, cauliflower, peas, corn, squash, mushrooms

Grains Brown or white rice*, oatmeal, popcorn*, quinoa*, barley, bread, crackers, pasta, tortillas, couscous, grits, pretzels, pita, bagels

Protein Chicken, turkey, beef, fish, shrimp, beans, tofu, nuts (almonds, pistachios, walnuts, cashews), seeds, eggs, peanut butter

Dairy Milk, milk alternatives (soy, rice, almond, help, coconut), yogurt, cheese, cottage cheese, frozen yogurt, ice cream



* = gluten-free; other foods may or may not be gluten-free, depending on specific ingredients

Autism: Special Diets

A brief guide to two specialty diets commonly used to treat autism

For more information, please visit the following websites:

http://www.eatright.org/resource/health/diseases-and-conditions/autism/autism-spectrum-disorders-asd-and-diet

http://www.autism.com/treating_diets

http://www.tacanow.org/family-resources/what-is-casein/

http://www.tacanow.org/family-resources/going-gfcfsf-in-10-weeks/

http://www.webmd.com/brain/autism/gluten-free-casein-free-diets-for-autism?

Background

Many different specialty diets are currently used by parents in an effort to reduce the symptoms related to their child's autism. It is believed that children with autism have an immune reaction to proteins like gluten and casein. However, further research to support these diets needs to be conducted. If not followed properly, they can even cause nutrient deficiencies in your child. A specialty diet may be helpful in your unique situation, but it must be followed with care.

Two of the most common diets for autism are discussed in this handout: Gluten-free and Casein-free.

As always, it is important to consult your child's doctor or dietitian before making any dietary changes. This handout will provide a few tips to ensure that your child consumes a well-balanced diet and stays as healthy as possible.

Gluten-Free

Gluten is a combination of two proteins, called gliadin and glutenin. It is found in wheat, rye, barley, and any foods made with these ingredients. Use the following tips to plan a healthy and well–balanced gluten-free diet for your child.

Tips:

Avoid cross contamination: Some foods are naturally GF, but have been processed with gluten containing products. Be sure to check labels.

Remember hidden sources: Gluten can be found as an additive in food products, as well as in non-food items, such as lotion or chapstick.

Check for lacking nutrients: Sometimes GF products have lost important nutrients in processing. Talk to your child's doctor or dietitian to ensure that their GF diet is well-balanced. Specific nutrients to ask about include fiber, iron, magnesium, vitamin D, and the B vitamins.

Explore new grains: Panel 3 contains a list of naturally GF grains and flours that can be substituted for wheat, rye, or barley in most recipes.

Casein-Free

Casein is a protein that is found in all animal milk, including cow's milk, goat's milk, sheep's milk, etc. Below you will find some common sources of casein and tips for removing casein from your child's diet.

Tips:

Sources: Casein can be found in milk, cheese, yogurt, butter, ice cream, sour cream, Cool Whip, sherbet, milk chocolate, seasoning on some snacks, etc.

Check labels: Make sure to always check labels for hidden sources. Many soy and imitation dairy products also contain casein.

Lacking Nutrients: Because dairy products are a major source of calcium and vitamin D, make sure that your child consumes other sources of these nutrients. For example, sources of calcium include white beans, broccoli, canned salmon, dark leafy greens, and almonds. Sources of vitamin D include fatty fish, eggs, a

Eating Ou

Providing a gluten-free/casein-free diet can be difficult when you are eating at home. It can be even more challenging when eating out at a restaurant or fast food place. Here are some tips to eating a GF/CF diet away from the home.

Tips:

Call ahead: Inform the restaurant ahead of time of your child's special diet. Make sure they are able to accommodate you.

Talk to the chef/manager: Ask to speak to the person in charge to discuss GF/CF options.

Plan in advance: Look at the menu and decide what to order before leaving the house.

Gluten Containing Grains	Gluten-Free Grains & Flours
Wheat	Amaranth
	Arrowroot
	Buckwheat
	Corn (Maize)
Wheat varieties (bulgur, couscous, dinkle, durum, einkorn, emmer, farro, farina, fu, gliadin, glutenin, graham flour, kamut, matza, seitan, semolina, spelt, wheat berry, wheat grass, wheat germ, and wheat nut)	Dasheen flour
	Kasha
	Kudzu
	Manioc
	Millet
	Milo
	Oats*
	Potato flour
Barley	Quinoa
	Rice (all varieties)
	Saffron
Rye	Sago
	Sorghum
	Soy
Wheat & Rye varieties (MIR, triticale)	Tapioca
	Taro flour
	Teff

*Oats are gluten-free but are often contaminated with wheat during growing or processing. Look for pure, uncontaminated oats when purchasing to ensure a gluten-free product.